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Nelson River Crossed by Hudson Bay Railway on Large Continuous-Truss Bridge

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Volume 81 August 29, 1918 Number 9

Engineering News-Record

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E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

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AND CONTRACTING

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Milwaukee Says "No"

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Help-Win-the-War Water-Works Meeting

DENYING itself excursions, entertainments and exhibits the New England Water-Works Association will hold a strictly business meeting on Sept. 11-12. The program, outlined on p. 422, consists largely of help-win-the-war topics. These as well as the other items on the program are of vital importance today. Attendance at Boston will help the water-works superintendent and engineer in his daily tasks besides being a patriotic duty.

Action as Well as Denial a War Duty

SOME technical societies deny themselves their usual conventions as a war-time duty. Not so the water-works associations. They are adjusting their conventions to war-time conditions. This is notably true of the New England program mentioned just above. All potential society forces must be utilized to the utmost—conventions, committees, each member. Conventions give unity, inspiration, push. Action as well as self denial is a war-time duty.

Drawbridge Operators Must See Entire Moving Span

IN THE layout of a drawbridge one thing is essential: the operator must have a clear view of the entire moving part of the bridge so as to be sure that the roadways are clear before opening the span. This seems elementary, but a recent accident in a San Francisco lift span makes its repetition worth while. On this bridge the operating house does not command a view of the far end of the lift and the attendant raised the span while an automobile was crossing the bridge. The four passengers jumped from the car and clung safely to the network during the cycle of lift. The driver stuck by the car and was in it while it slid down the raised floor and into the water through the small clearance under the fixed span. In passing through the opening the top was scraped from the car but fortunately the driver escaped unhurt. Such an accident is rare, but that it can occur at all is sufficient evidence that it should be provided against.

Begin or Bust

TURN to p. 421 and read "Begin or Bust." Then ask yourself if your slogan is "Begin or Bust" today and every day till the boys come home. "Begin or Bust"—it's the only motto now for red blood and loyal hearts. We do not know who wrote "Begin or Bust." The author did not sign his name. We would like to know him and shake his hand. And if he sends his name we'll print it—if his modesty will permit.

Water Control World Wide: Criminal Waste at Chicago

WATER resources the world over are being inventoried and conserved. On p. 407, studies, legislation, measurement and control of Russian supplies in far away Hawaii are outlined, including the use of both the piezometer and the current meter on artesian wells. In our issue of Apr. 4, 1918, p. 687, a Russian hydrographic engineer told how measurement of water in Russian Crimea was being extended to hundreds of streamlets and springs. In this country, irrigation canals are being lined, closed conduits used, and various measuring devices introduced to save water. Municipal water waste is being ferreted out by surveys and prevented by the adoption of the universal meter system. Meanwhile Chicago and some other American cities are really burning thousands of tons of coal in war time in order to pump almost unimaginable volumes of water to run to waste without serving a single useful purpose. It is high time they were halted—if not by their own volition then by the war-emergency powers of the Federal Government.

Contractors Sublet Worry

MANY schemes are being adopted, due to present conditions, which a few years ago would have been considered impracticable. New methods are being developed, new practices are springing up, and it is increasingly evident that a mixture of old and new is being fused in the crucible of these tremendous times, into a combination which will have more or less fixed characteristics after the war. That the contract system of the country are at present passing through such a change is evidenced by an article on heavy haulage contracts appearing in this issue. Large contracts are

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the order of the day; the contractors are working for a nominal profit. Under these circumstances the general contractor is seeking ways to relieve himself of details. The new form of haulage contract accomplishes this by removing the multitudinous equipment repair and operation troubles. The haulage contractor for a certain rate per day furnishes the trucks, maintains them and supervises their operation. The general contractor utilizes them, but has sublet the worry. It is in harmony with the principle of division of labor.

New York Prepares for a Marine Revival

NEW YORK CITY has one of the great natural harbors of the world. Provided with many miles of protected water-front practically on the ocean itself, and backed by a rich interior convenient of access, it could hardly avoid developing into a great port. So favorable has been its natural endowment and so easy its inevitable development the impediments to future growth, if not forgotten, have often been disregarded. One of these impediments—the narrowness of the Manhattan peninsula—is natural; the other—the divided control of the two sides of the Hudson River at its mouth—has been part and parcel of our form of government.

Of the two, the latter is the more serious, because the cure for the former is within the realms of engineering and is therefore possible. Correcting the evils of the divided control, with its attendant jealousies, rivalries, and narrowness, is a harder task. Though it has become well recognized that the future of the port is menaced by a lack of co-ordinated policy, it has been the hardest thing in the world to get the various interests together for future planning. It is a literal fact that in the not very distant past there were influential men in New York City who would rather have seen a new industry or port development go to Boston or Philadelphia than to Jersey City or Bayonne.

Traces of this feeling may still exist, but the apparent smooth operation of the New York-New Jersey Port and Harbor Development Commission points to its early disappearance. How elaborate a problem the Port of New York presents is well shown by the latest report of that commission, abstracted on another page. After many efforts at joint action, the present commission seems at last to have perfected an organization which will see the Port of New York as a whole and will be able to state the problem and to offer a reasoned solution. How well the port will be able to profit by the investigation will depend on the ability of the state and municipal interests concerned to sink their individuality in the good of the port.

Other American ports must take notice of New York's awakening. Our mammoth post-war merchant marine must have business, and in marine transportation, as in all other transportation, terminals are of the first importance. The port is the marine terminal. Unless the coast cities of the country begin right away to plan and actually to build the docks, wharves, warehouses, and terminals which most of them now so sadly lack, the great fleet of fabricated freighters now sliding into the water day after day will be useless.

Smashing Through to Victory

WASHINGTON is different today from what it was July 1. Then the spirit of last April prevailed—an active, energetic spirit, suffused with optimism as to the ultimate result of the war. It has been quickened by the presence of our men on the front. But the program was still a limited one—the man-power to be chosen only from the 21-31 ages. True, the military authorities were planning on extending the draft ages, but the temper under which Washington was working was that of a limited program, now running smoothly after a year of confusion.

Now all is changed. Victory has put Washington on its mettle. We have tasted success. Nothing may stand in the way of the most rapid possible mobilization of all our forces. The effort will be super-human. All our energy is to be brought to bear. As a keen observer, himself in the thick of the enlarged plans put it, "This means business."

Approximately 2,300,000 will come out of the new draft ages, exclusive of the boys, just 21, who enrolled last Saturday. They will all be in the field a year hence. Thus the man-power will be provided.

The home backing is also in course of very rapid mobilization. It is not coincidence that industrial restrictions have come with avalanche rapidity during the past 60 days. It is part of the new spirit and program, "Our full resources into the conflict with the utmost speed." Moreover, the 25 per cent. restriction of today will be a 50% restriction tomorrow, if the big program requires it.

And to none of this do we object. It means readjustment, possibly hardship—but it means a shortening of the war. It means a crushing defeat for Germany next year—and the saving of thousands of lives.

Our utmost energies are going into the conflict. Who will hold back?

We have the Germans on the run. The pace shall not slacken till their defeat is overwhelming.

Coercion Still by Valuation Bureau

GOVERNMENT valuation men who seek to better their lot still encounter attempts on the part of at least one district office of the Bureau of Valuation to bar them from employment by the railroads, according to information received by *Engineering News-Record*. This journal commented on the practice in its issue of Sept. 27, 1917, p. 577, at which time it was assured by the director of valuation that he had no knowledge of it. Now we are told that one railroad valuation engineer has agreed not to hire Government men within 90 days of the time they leave the Government service.

The Bureau of Valuation may have a shadow of an excuse for its attitude in the shortage of men, and the general policy of the Government to discourage competitive bidding for labor on war work. It is only a shadow of an excuse, however. While continuation of the valuation work was authorized by Congress recently, the work is far from a war necessity. Furthermore, the engineer with individuality and special proficiency along certain lines can not fairly be classed with the laborer who with his eyes, arms and legs does his

work about the same way as thousands of others. If the engineer can find a market for his special talents he should be allowed to sell them. Another arm of the Government, the Railroad Administration, has in fact helped him find that market by raising the scale of pay for its employees to something more in keeping with their value and the cost of living.

Engineering News-Record is not willing to believe the valuation engineer referred to would have consented to the 90-day clause unless considerable pressure had been brought to bear upon him. Appearances are, not that the bureau's district office, lately conscious of the necessity of its work to the winning of the war, and feeling the increasing shortage of men willing to accept its terms, has resumed a practice once condemned, but rather that it never abandoned the practice. And since district officials probably do not ignore the instructions of their superior, the director of valuation evidently now approves the coercion of which he had no knowledge last fall.

Making the War Help Win the War

SYSTEMATIC handling of army garbage, as practiced by the Conservation and Reclamation Division of the Quartermaster Corps of the Army, is making the war help win the war. Incidentally, the value shown to exist in garbage and the methods followed to raise them to the highest possible level afford a useful lesson to American cities. This will be made clearer by referring to the tabulation of bids for garbage at 35 Army camps, printed on p. 424 of this issue.

Contractors the country over recognize the value of garbage by offering to pay the government good money for it. That these offers are not mere speculative guesses is proven by the fact that 16 of the 19 contractors whose names were given in the partial list of 1917-18 contracts published in *Engineering News-Record*, Oct. 18, 1917, p. 731, appear in the 1918-1919 list as having secured contracts at the same camps as last year. One of these contractors operated at four camps last year, while for the current year he has the same four and one more.

A unique feature of this year's bids is that separate prices were requested on the component elements of the camp garbage. The highest, lowest and average prices

TABLE I.—RANGE AND AVERAGE PRICE PER TON OF CAMP GARBAGE COMPONENTS

	Low	High	Average
Breads	$3.50*	$100.00	$29.20
Meats, fats, grease	3.50*	160.00	62.60
Bones	3.50*	30.00	16.60
Other garbage	.50	8.20	2.70
Dead animals, each	1.00	3.00	2.10
Estimated total yield per ton	2.41	22.18	9.38

*All at Camp McClellan, Ala.

under this plan of bidding are summarized in Table 1 herewith. At army camps, where military discipline prevails, it appears to be feasible to carry the separation of wastes as far as the authorities see fit. In many cities it is difficult to get even a separation of garbage from all other refuse. When our cities see that separation pays, the difficulty will be more readily overcome. Even though waste separation cannot yet and perhaps never need be carried as far in cities as in camps, the segregated camp bids will be of much value to garbage disposal engineers and contractors and to city officials who are giving careful attention to getting the most possible out of municipal wastes.

Estimates of the yield per ton of garbage are given for each camp in the large table on p. 424 and appear rearranged from lowest to highest in Table 2 herewith. The average for 30 camps is $9.38 per ton. This is as close as could be expected to the median figure, there being 15 camps at which the yield per ton is estimated at $9.40 or less and 15 at which it is $9.44 or more.

Geographical distribution of the bids does not seem to have been much of a factor in the variation in estimated total yield of garbage per ton. It is true that the four lowest bids are from the South, but a number of other Southern bids are very near the average and some are quite high. Of the two highest bids, one is from a camp in Massachusetts and one, the very highest, from a camp in California.

Figures showing the total yield from the garbage from all the camps after records have been kept for a number of months or a year would be valuable. They will doubtless be compiled by the Conservation and Reclamation Division for its own benefit, and it is sincerely to be hoped that they will be made public. Even though there be material differences between camp garbage and city garbage, all the evidence that can be accumulated regarding camp garbage will be of immense value to

TABLE II.—ESTIMATED YIELD PER TON FROM ALL CLASSES OF GARBAGE AT 30 ARMY CAMPS

Camp	Yield	Camp	Yield
Greene, N. C.	$2.41	Doniphan, Okla.	9.784
McClellan, Ala.	3.50	Sherman, Ohio	9.86
Sevier, S. C.	5.02	Grant, Ill.	10.15
Newport News, Va.	5.655	Pike, Ark.	10.40
Lewis, Wash.	5.69	Taylor, Ky.	10.76
Lee, Va.	6.05	Upton, N. Y.	11.05
Logan, Tex.	6.20	Sheridan, Ala.	11.39
Custer, Mich.	6.654	Wheeler, Ga.	11.39
Dodge, Iowa.	7.41	Beauregard, La.	11.76
Cody, N. M.	8.86	Dix, N. J.	11.98
Jackson, S. C.	8.97	Meade, Md.	12.04
Funston, Kan.	9.11	Travis, Tex.	12.13
Johnston, Fla.	9.17	Devens, Mass.	15.07
Merritt, N. J.	9.38	Fremont, Calif.	22.176
Gordon, Ga.	9.40		
Hancock, Ga.	9.44	Average	9.38

our cities and will unquestionably stimulate them to utilize their garbage in the future as never has been done in the past.

Assuming that camp garbage yields attain the estimated average of $9.38 per ton, no one should suppose that this is all profit. The military authorities have to collect the garbage and deliver it to the contractors. But, once collected, the garbage must be got rid of. Until recently it was assumed that the only sanitary way that camp carbage could be disposed of was by burning. Today, instead of paying money for fuel and labor to consume garbage, contractors pay for it handsomely. Whether or not camp garbage yields the estimated average total of $9.38 a ton, city garbage will not bring anything like that average. But in every city it can and should be made to contribute materially to the cost of collection and disposal. To get every possible dollar from it the problem of both collection and disposal must be handled by competent engineers.

For the present and probably for a long time to come there is a double reason for utilizing garbage and other city wastes to the utmost. Food, fiber, fertilizing material and metals running to millions of tons a year go into our garbage and rubbish cans. Besides the revenue that our cities and our military camps get from the material reclaimed, the material itself is of vital importance to winning the war and to the success of reconstruction efforts.

Nelson River Crossed by Hudson Bay Railway on Large Continuous-Truss Bridge

Cantilever Erection of 400-Ft. Span Made Necessary by Deep Water With Rapid Current—Ice Gorges Dictate Clearance Height—Floor Between Chords—Material Transferred to Far Bank by Cableway

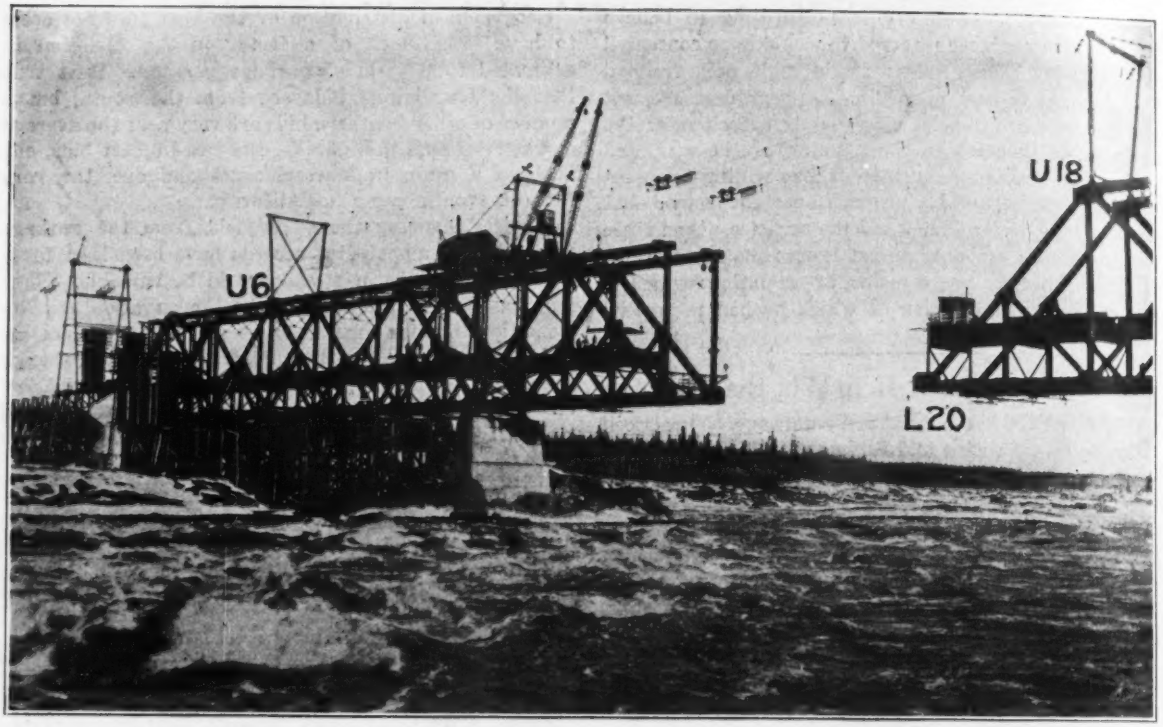


FIG. 1. KETTLE RAPIDS BRIDGE, NORTH HALF CANTILEVERED OUT BY TOP-CHORD DERRICK TRAVELER SUPPLIED WITH MATERIAL FROM SOUTH BANK BY CABLEWAY

REACHING Mile 332 on its way to its northern terminus, the Hudson Bay Ry. has crossed the Nelson River at Kettle Rapids by a bridge of highly modern type—a three-span continuous bridge 1000 ft. long. The structure is the most important one on the railway, which is now completed for three-quarters of the total length of 424 miles from The Pas, on the Saskatchewan River, northerly to Port Nelson on Hudson Bay.

The physical conditions at the Kettle Rapids crossing gave the continuous structure a distinct superiority over other types. Rapid current, a deep channel, and remarkably severe winter ice conditions made erection by the cantilever method imperative. Simplicity of design was secured by use of parallel chord continuous-truss construction in a degree that made the erection unusually rapid. That the precision of modern bridge shop and field erection methods is of value in continuous bridge work was evident when closure was made at the middle of the channel span. The position of the structure and the reactions at its supports corresponded to those predicted by calculation, within very close limits, so close that no further adjustment was required. Rock foundations of piers and abutments assure the permanence of the structural adjustment.

Though the Nelson is among the large rivers of Canada, two islands at the point of crossing, narrowing the channel to 350 ft., made it possible to cross by a bridge of moderate size. In this narrow channel, however, the water is 200 ft. deep (estimated), and the current is so swift that the river never freezes over at this point, though it does directly above and below the site. The side channels, on the other hand, are narrow and shallow and have a slow current; the bottom here and the islands are tough granitoid gneiss, which is also the foundation material of the abutments on the banks.

Both water and ice conditions are unique. The Nelson River has almost no variation in stage throughout most of the year (maximum observed, 3 ft.), because of the equalizing effect of Lake Winnipeg. In winter, however, rises of 20 ft. and more occur, due to ice jamming. The peaks of the ice rise 5 or 6 ft. above this level, the highest occurring on the islands on which the two river piers are situated.

A clearance height of 15 ft. above the maximum recorded height of ice was decided upon, for due safety in all future winter conditions. In the winter of 1917-1918 the severest weather of which there is any official record along the line of the Hudson Bay Ry. was experienced, but the maximum height of the ice peaks at Kettle Rapids exceeded previous records by only ½ foot.

Track grade on the approaches was at such height

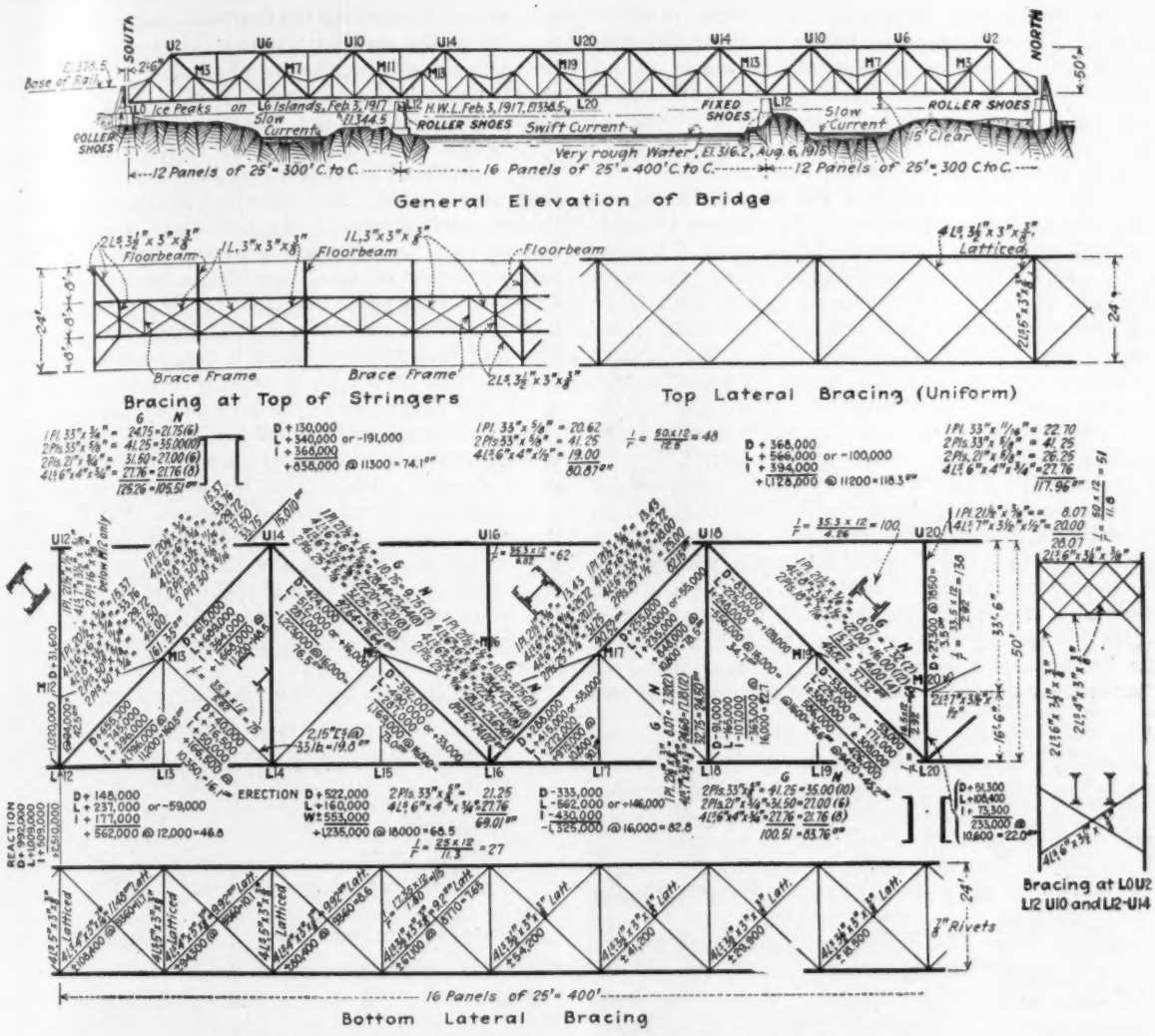

SOUTH
NORTH
U2 U6 U10 U14 U20 U14 U10 U6 U2
M3 M7 M11 M15 M19 M13 M7 M3
Base of Rail
Ice Peaks on L6 Islands, Feb 3, 1917 El 344.5
Slow Current
ROLLER SHOES
H.W.L. Feb 3, 1917, El 336.5
Swift Current
FIXED SHOES
Slow Current
ROLLER SHOES
5' Clear
Very rough Water, El 316.2, Aug. 6, 1918
12 Panels of 25' = 300' C. to C.
16 Panels of 25' = 400' C. to C.
12 Panels of 25' = 300' C. to C.
General Elevation of Bridge
Floorbeam
Brace Frame
Bracing at Top of Stringers
Latticed
Top Lateral Bracing (Uniform)
ERECTION
Bottom Lateral Bracing
16 Panels of 25' = 400'
7/8" Rivets
Bracing at L0U2 L2U10 and L2U14

FIG. 2. ELEVATION OF BRIDGE AND STRESS SHEET OF MAIN SPAN

that, keeping the bottom chord down to the clearance level mentioned, for economy in pier masonry, the bridge floor came near mid-height of the trusses. This position and the engineer's choice of the Warren web system in the trusses resulted in an unusual appearance and detail arrangement of the structure, as may be seen in the outline elevation, Fig. 2. The floor stringers are braced to the truss posts at main panel points to stiffen the floor against longitudinal or braking forces, and from the posts these forces are transferred to the carrying members of the web system by slightly inclined longitudinal struts.

That the continuous-span type of bridge was chosen in preference to a normal simple-span or cantilever design resulted from a careful comparison of the three forms of bridge. The location required a structure 1000 ft. long, with three spans of 300, 400 and 300 ft. The side spans could be erected on falsework, while the center span had to be built by cantilevering. Simple spans could have been adapted to these conditions without difficulty, but a considerable excess of metal would have had to be provided on account of heavy erection stresses. In either a cantilever or continuous structure, on the other hand, no excess metal for erection was required except a small amount in the bottom chords adjacent to the main piers. The simple spans were rejected as uneconomical. A cantilever structure was considered undesirable because of the articulation at the connection of suspended span to cantilever arms, and also, as the design in this case would have employed greater depth over the piers than at midspan, because of the extra cost of shopwork involved by inclined

FIG. 3. HEAVY HOAR FROST DUE TO EVER-OPEN WATER IN RAPIDS AND EXTREMELY LOW TEMPERATURE

chords and irregular webbing. The continuous bridge afforded maximum economy, and, with a parallel-chord design and without moving joints or points of adjustment, was by far the simplest in shopwork and in erection. The sizes of parts were well within the limits for full riveted construction, as desired to avoid slack in members subject to stress reversal.

Continuous-span construction was adopted for the reasons stated. A truss depth of 50 ft., uniform throughout the length of the structure, 24-ft. spacing of trusses, and panels 25 ft. long, were decided upon. The truss web was arranged on the Warren system with intermediate verticals and subpaneling—the main panel length being 100 ft., diagonals sloping at 45°. Warren webbing was adopted, says W. Chase Thomson, because it is the most economical, especially where many of the web members are subject to alternating stresses, and because of its simplicity and good appearance.

Locating the track floor between the chords—which resulted from keeping the steelwork down to the river-clearance limit—not merely effected a considerable saving of concrete in the piers and abutments, without adding to the weight of the steelwork, but also gave several other advantages: (1) The structural details were simplified by keeping the floorbeam connections clear of the lower panel point; (2) a better distribution of stress among the component parts of the main members was secured by applying the floorbeam concentration well away from the end connections; (3) change of length in the floor due to lengthening or shortening of the truss chords under load was greatly reduced by placing the track stringers near the neutral axis of the trusses.

Although far from other lines of traffic, the bridge was proportioned for rather heavy loading—slightly less than Cooper's E50. As is provided in the 1908 railway bridge specifications of the Canadian Department of Railways and Canals, which governed the design, a live load consisting of two consolidation locomotives with 49,400 lb. driving-axle load, followed by a uniform train load of 4750 lb. per linear foot of track, was assumed. The dead load was distributed to top-chord, middle and bottom-chord points as it actually occurs. Wind of 400 lb. per linear foot at rail level and 400 lb. (moving) at 8 ft. above rail was allowed for; however, the bottom laterals were proportioned for the whole amount, and the chord stresses arising from the overturning moment were added to the other chord stresses. For the erection period the dead loads actually occurring, together with either a 150,000-lb. derrick car or a 120,000-lb. creeper traveler, and wind of 600 lb. per linear foot at rail level, were taken into account; unit stresses increased 50% were allowed for the resulting erection stresses.

Working stresses are fixed by the specifications men-

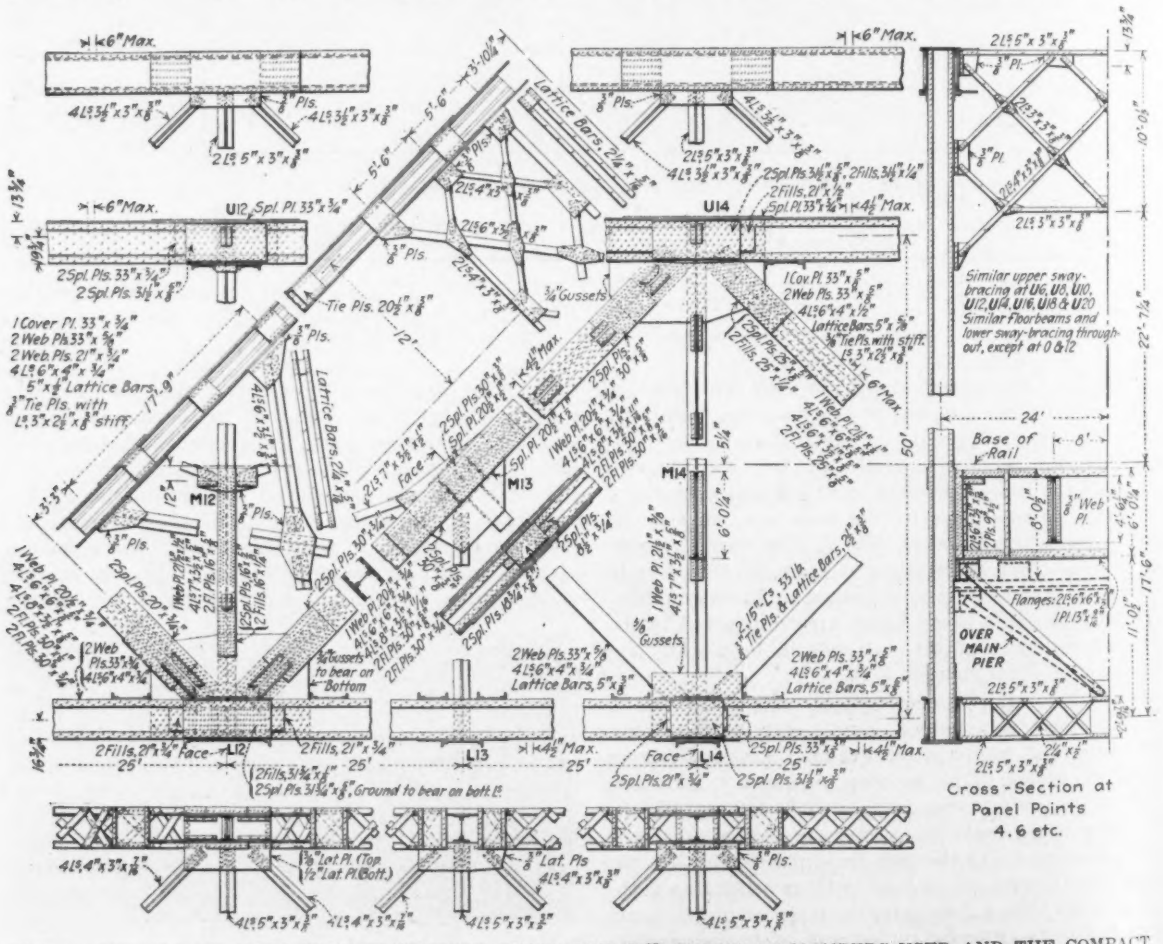


FIG. 4. DETAILS OF MAIN SPAN REPRESENT TYPICALLY THE FORMS OF MEMBERS USED AND THE COMPACT CONNECTIONS SECURED BY OUTSIDE SPLICE PLATES

tioned at 16,000 lb. per square inch for tension, and at the same figures as base stress for compression with reduction by Gordon's formula using a constant of 9000 for pin-end struts. However, in designing the Kettle Rapids bridge the compression base stress was fixed at 12,000, and the reduction constant in Gordon's formula at 36,000. Another important variation from the department specifications was made by reducing the impact allowance in case of live-load stresses of opposite kind. The impact formula of the specifications, $I = \text{range}^2/(\text{max. stress})$, was modified in application by making the range not the sum of greater (positive) and lesser (negative) live-load stress, but the sum of greater and four-tenths the lesser. Where the live-load stress did not reverse, the formula was applied as originally intended, the range being simply the maximum live-load stress, so that the impact is $I = L^2/(L + D)$.

Of the details of the bridge, shown typically in Fig. 4, the longitudinal diaphragms of the principal compression members attract notice. The designer sought to avoid latticing where possible, except for service in staying the open sides of members. The main compression diagonals have their outstanding flanges stayed by tie-plates.

One of the two pier bearings is fixed; all the other bearings have expansion rollers (8-in. on the main pier, 6-in. on the abutments). The expansion rollers are effectually prevented from skewing and creeping by cut-tooth pinions, attached to both ends of two rollers of each nest and gearing with racks on the shoe- and bed-plates. All four bearings are of the pin type, upper and lower shoes being steel castings. The lower shoe (in the case of the expansion bearings, the steel bed plate of the rollers) was cushioned on a $\frac{1}{8}$-in. sheet of lead, the bridge seat being previously dressed to exact elevation and level.

Splices and connections were made with rivets sufficient to develop the full value of the connected parts. That the gusset plates are small, as may be seen from Fig. 4, is largely due to the use of outside splice plates at the connections of the main diagonals. The connections at the middle panel points and the bottom connections at panels 2, 6, 10, 14 and 18 have gusset plates only $\frac{3}{4}$ in. thick. At the upper panel points 10 and 14 the size and thickness of the gusset plates were determined by the shearing forces acting on the plates.

At the main-pier panel point (L12), where the bottom chord because of the camber is slightly inclined to the horizontal—$\frac{1}{4}$ in. per foot—a level bearing on the shoe casting was secured by extending the gusset plates $\frac{1}{8}$ in. below the chord. Additional bearing area was obtained by placing tapered fillers under the bottom flange angles of the chord. The outside splice plates of the chord at this panel point were ground along the lower edge to bear on the inner surface of the flange angle so that they might assist in transmitting the vertical load to the flange (and by way of the tapered pillars to the shoe). For this service the splice plates have additional rivets over and above the number required for splicing the bottom-chord sections.

Since the bridge had to be erected with its ends low, to permit junction at midstream under no-stress conditions, provision for jacking up the bearings was necessary to enable the desired adjustment of stresses in accordance with calculations to be obtained. Jacking may also be required in future when bearings need to be examined or replaced, or when it might be desired to shim up one of the supports for readjustment of stresses. The floorbeams at the four bearing points were therefore constructed strong enough for the purpose. The end floorbeams—which unlike the intermediate floorbeams carry the stringers on their top flanges—were fitted with stiffeners and bearing plates at points 16 ft. apart, where jacks were applied later. The floorbeams over the main piers were built 96 in. deep in place of the 72-in. depth of the ordinary floorbeams and were fitted with double webs in the end section; these floorbeams are capable of lifting the bridge, with unit stresses increased 50 per cent.

FIG. 5. STRUCTURAL ARRANGEMENT OF BRIDGE SEEN IN END VIEW OF SOUTH HALF DURING ERECTION

The bridge was cambered without regard to securing a level position of the bottom chord under any particular condition of loading. The unstressed form is as shown to exaggerated vertical scale in the upper sketch in Fig. 7. This shape was secured by increasing the length of the top-chord panels $\frac{3}{4}$ in., except the two panels U10 U12 and U12 U14, which were shortened an aggregate amount of $1\frac{1}{4}$ in. The post over the main piers were lengthened $\frac{3}{4}$ in. to straighten the top chord. Minor adjustments of the lengths of diagonals were made. The abutting chord ends at L12 were beveled to give perfect contact when the trusses are fully loaded.

For erecting the bridge, a 75-ton derrick car with 50-ft. boom placed the members of the southern anchor span (on falsework) and, after the anchor span had been fully riveted, also erected the south half of the channel span as a cantilevered structure. In this span riveting followed close behind erection. In all this work material was handled directly from the bridge floor. A radically different procedure had to be followed on the north side, however, because the material arrived on the south bank. The essential feature of this part of the work was transportation across the river by a double cableway, supported directly over the bridge.

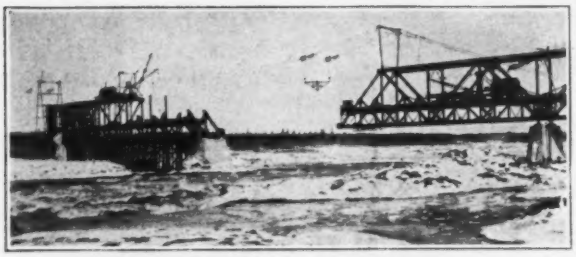


FIG. 6. FOR TRANSPORTING MATERIAL TO NORTH SIDE, A DERRICK CAR ON SOUTH END SUPPLIED MATERIAL TO DOUBLE CABLEWAY FITTED WITH EQUALIZER BEAM

Two of the photographs shows the cableway in operation. A 40-ft. bent standing on the south half of the bridge at panel point 18, and a 120-ft timber tower located back of the north abutment supported the cables with a span of 611 ft. For the later part of the north bank work, however, the span was reduced to 400 ft. (decreasing the sag under maximum load from 46 ft. to 22 ft.) by placing a 40-ft. bent on panel point U6, north half, as intermediate support. A triangular equalizer beam supported by the carriages on the two cables served for lifting the loads and distributed their weight equally to the two cables. Falsework, parts of the north-bank erection traveler, and bridge members were transported across the river by this cableway. The heaviest piece handled weighed 14 tons.

The order of erection work was in other respects similar to that followed on the south half, except that in place of the derrick car a top-chord traveler carrying two 62-ft. booms at its front end was used. This traveler weighed 60 tons including counterweights. In placing the members of the north shore span it operated at the floor level, being carried on extension bents of the falsework, reaching up to floor level. For the cantilever work it traveled on the top chord. Here the weight of the traveler made necessary temporary support of the top-chord members at their middle points by timber posts.

Starting steel erection on the south bank June 6, 1917, the half length of the bridge was completed in eleven weeks, or by Aug. 18; riveting was finished within another week. Building the cableway and placing the falsework for the north shore span took until Sept. 17, when steel erection was resumed. The traveler began its work at the river pier and moved backward toward the abutment, placing floor system, bottom laterals and lower half of the trusses and removing the falsework extensions. Upon arrival at the abutment the traveler was blocked up to the top chord level; moving forward toward the pier it erected the upper half of the trusses. Then it worked out along the top chord, erecting the channel span as cantilever work.

By the end of November the two halves of the bridge met at midspan, and the bottom chords were joined at panel point 20. The trusses were in perfect alignment and the two cantilever halves were at the same level, so that is was only necessary to jack the south half of the structure forward on its rollers (it had originally been set back 5 in.), to make the connection at L20.

In starting steel erection the end panel points had been set 10 in. low, in order to allow the bottom chord to be joined at midspan, and yet allow the closing top-chord section to be set freely. When the top-chord member was placed, there was a 1-in. gap. It remained to raise the end supports up to their proper level in order to close the top-chord opening and put the full calculated dead-load stress in the central section of the top chord.

Cold weather interfered with making this adjustment during December, however, except for a lift of 3¼ in. (accomplished Dec. 22), just sufficient to bring the ends of the top chords at U20 to firm bearing. Further jacking was deferred until riveting of the main connection was completed, which took the rest of the month. On Jan. 2 the ends were jacked up 4⅞ in. further, permitting the upper shoe castings to be slipped into place, without the 1⅝-in. shims which had been provided as means of give and take. Though the ends were below normal position, the load at each of the four end bearings, as read from the gages of the hydraulic jacks, was exactly equal to the desired dead-load reaction, or 118½ tons, but whether the adjustment was perfect could not be told because there was a large weight of ice and snow on the bridge, whose influence on the load distribution was uncertain.

Resuming work in June, 1918, the erection forces completed some remaining items of structural work; the permanent track was also laid. Upon now weighing the end reactions by the jacks, the engineers found the dead-load reaction at each of the corners to exceed the computed 118½ tons by exactly 5 tons, or about 4 per cent. This meant that the ends were slightly too high for the desired load adjustment, although a trifle below the originally intended level. The divergence from the theoretical reactions was within the limits of accuracy of jack weighing, and in any event was considered too slight to call for any effort to lower the ends—which would have required chipping the bridge seats or altering the shoes. The bridge was therefore left with ends 1⅝ in. low, as represented in the lower diagram in Fig. 7.

Referring to the slight departure from the intended position of the trusses, Mr. Thomson says, "This result

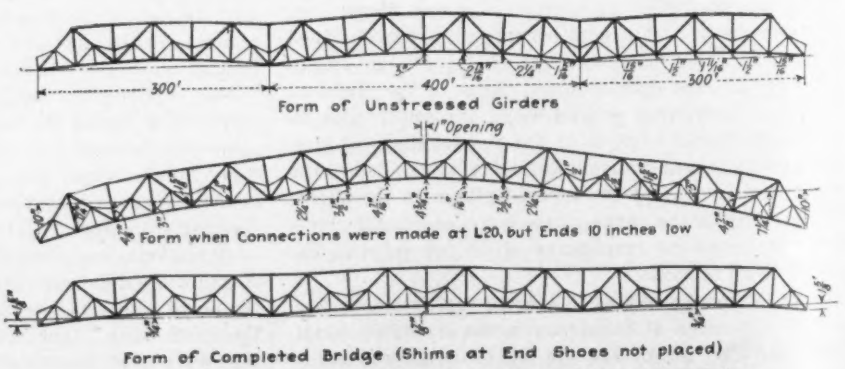

300'
400'
300'
Form of Unstressed Girders
1"Opening
Form when Connections were made at L20, but Ends 10 inches low
Form of Completed Bridge (Shims at End Shoes not placed)

FIG. 7. CAMBER DIAGRAMS FOR VARIOUS STAGES OF WORK

is as might have been expected. The cantilever erection of the channel span tended to increase the length of the top chord throughout, resulting in lowering the ends, though but slightly."

The total weight of steel in the bridge is 4,415,000 lb. The piers and abutments required about 3000 cu.yd. of concrete.

The design was carried out in all detail by W. Chase Thomson, consulting engineer, Montreal, retained for the work. It was under the general supervision of W. A. Bowden, chief engineer, Department of Railways and Canals of the Dominion of Canada, at Ottawa, and J. W. Porter, chief engineer, Hudson Bay Ry., at The Pas. The superstructure was fabricated and erected by the Canadian Bridge Co., Ltd., Walkerville, Ont. C. B. Campbell, bridge engineer, Hudson Bay Ry., was in charge at the site. I. E. Mahon was superintendent of erection for the superstructure contractor.

Weighing Concrete Materials Saved Cement on Three Big Dams

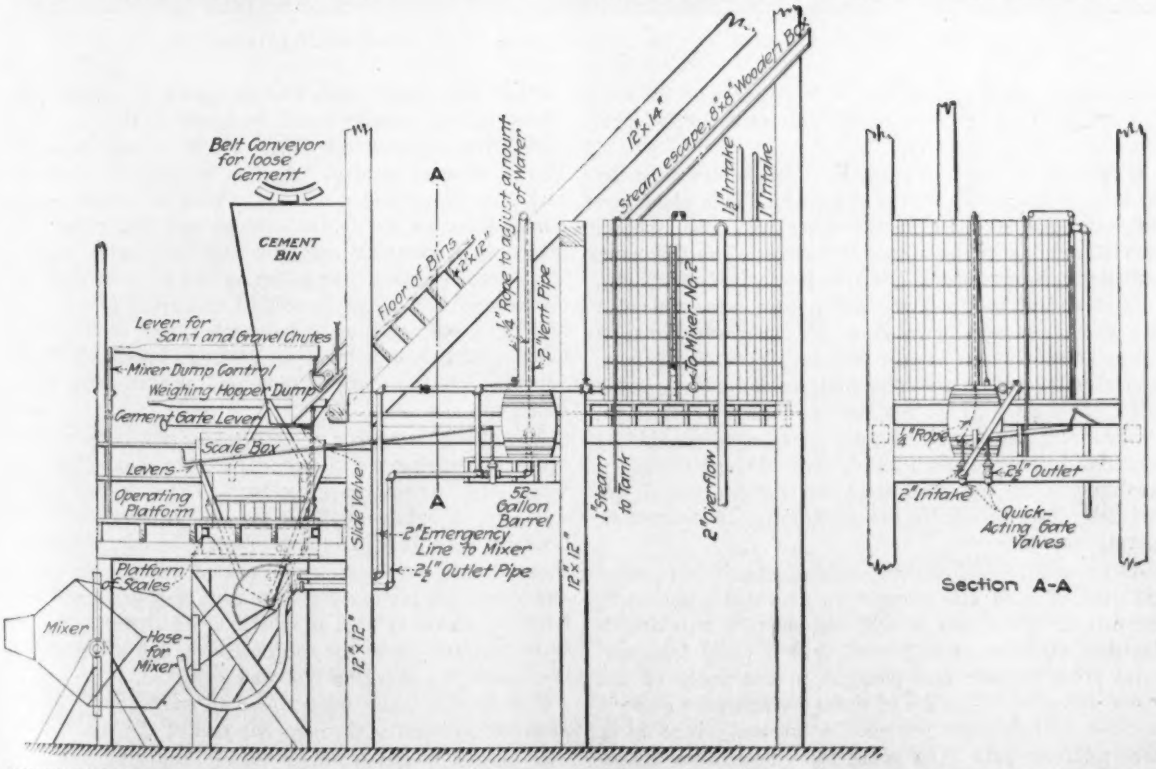
Cost of Equipping Mixer Plant for Weighing Not Excessive — Proportioning by Weight Gave Better Concrete With Less Cement and Without Loss of Speed

By H. H. Hunt
Fargo Engineering Co., Jackson, Mich.

CONCRETE proportioned by weighing the cement, sand and gravel reduced the volume of cement used on three hydro-electric developments completed recently in Michigan and Minnesota. For a total of 130,000 cu.yd. of concrete placed, the cement used per cubic yard ranged from 1.18 to 1.23 bbl. Void tests and occasional changes of the relative weights of the component materials kept the mixture uniform. Making the operations of the mixer plant as nearly as practicable all-mechanical the labor force was not increased and there was no appreciable loss of time due to the more exact methods of proportioning by weighing. One design of mixer plant was used for all three jobs.

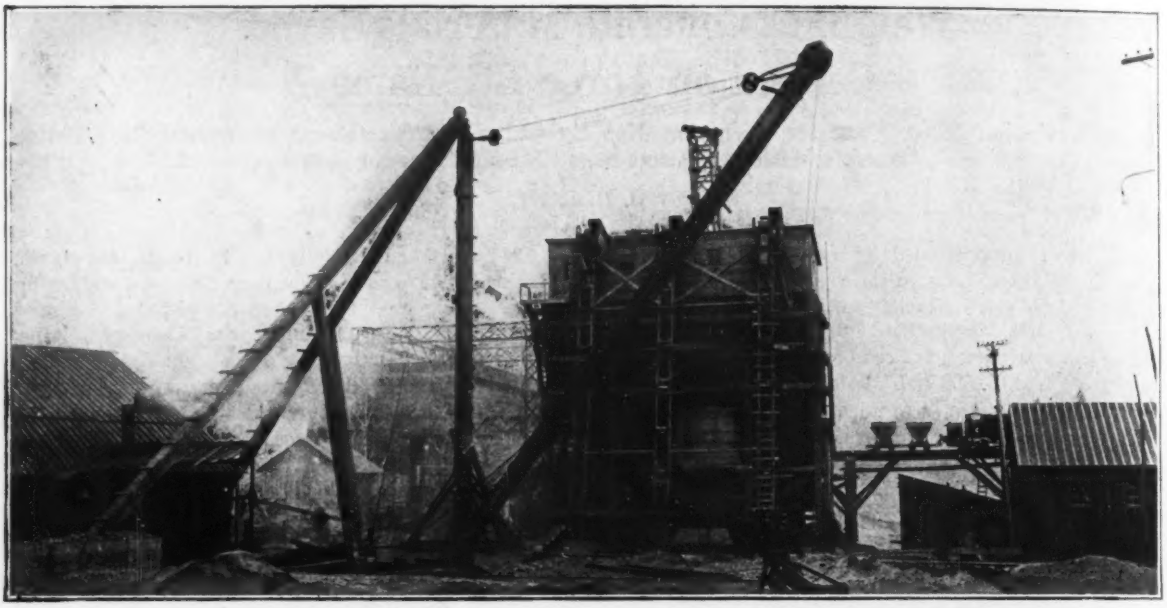
In 1917 and 1918 the following hydro-electric plants, for which the Fargo Engineering Co. were designing and supervising engineers, were completed and placed in operation: Wissota dam, near Chippewa Falls, owned by the Wisconsin-Minnesota Light & Power Co.; Junction dam near Wellston, Mich., and Foote dam near Oscoda, Mich., the two latter dams being owned by the Consumers Power Co. Wissota dam was of 60-ft. head and comprised 61,000 cu.yd. of concrete; Junction dam was of 50-ft. head and contained 47,600 cu.yd. of concrete, while Foote dam was of 35-ft. head and the volume of concrete amounted to 21,000 cubic yards.

The concrete specifications for these three develop-



MIXER PLANT DESIGNED TO BE KNOCKED DOWN AND REASSEMBLED — ALL OPERATIONS CONTROLLED BY LEVERS FROM ONE PLATFORM

ments were drawn in such a manner that the proportions were dependent upon the voids found in the sand and stone, and on account of the varying values of voids to be expected it was considered desirable to have a ready means of changing the relative amounts of sand, cement and stone. It was, therefore, decided that all material should be weighed so that any desired proportions could be obtained with a minimum of trouble. While this method has been used previously in a few cases, because of the exceptional success obtained here, a description of the plant layout, together with an outline of the steps involved in the determination of pro portions, is of interest.



DERRICK AND CLAMSHELL COULD SUPPLY BINS FROM EMERGENCY STOCKPILES

Details of the mixing plant used in constructing the Foote dam are shown by the drawings. This plant layout is typical of those at the other two jobs, though each differed from the others in details. The following description refers especially to the Foote dam operations.

Sand and stone from the dump cars were unloaded into the boots and elevated to the overhead bins by means of continuous bucket elevators 71 ft. 6 in. long, each elevator being provided with an individual motor drive. The capacity of the storage bins was 80 cu.yd. of sand and 160 cu.yd. of gravel, it being considered advisable to have enough material in storage so that a break down in the transportation system would not seriously interfere with the continuity of concreting operations.

As an additional insurance against shut downs, storage piles of sand and stone were provided adjacent to the mixing plant and a stiff leg derrick handling a clamshell bucket was so located that it could take material from storage and place it in the boots of the bucket elevators. The use of these storage piles made it possible to transport screened sand and stone at a more uniform rate than could have been done if dependence had been placed upon the storage capacity of the bins only, inasmuch as at such times as the mixing plant was not in use, transportation of materials from the screening plant would have been stopped when the bins were filled. As it was, a uniform output at the screening plant could be maintained, excess material over that used on any given day by the mixing plant being placed in storage, and, conversely, being taken from storage on those days when the output of the mixing plant exceeded the capacity of the screening plant. Steam pipes were provided in each bin to prevent freezing of sand and stone in cold weather.

When the mixer plant was in operation cement was loaded onto a push car and transported to a dumping pocket located over the lower end of a belt conveyor. The sacks were emptied into this pocket and the empty sacks were stored in a small shed nearby. Before being bundled for return to the cement mill the sacks were placed in a cleaning machine and thoroughly shaken. The dumped cement was taken by the belt conveyor and discharged into a bin located at the front of the sand and stone storage bins and directly above the charging hoppers of two cube mixers. Sliding cut-off gates were provided on the cement bins and proved very satisfactory.

The charging hopper of each mixer was supported on the framework of a Standard hopper scales provided with a four-beam charging box. Three of the beams were graduated to 1600 lb. by 5-lb. intervals and one beam to 3000 lb. by 10-lb. intervals. In operation, only three of the beams were used; one each for cement, sand and stone. A testing engineer was responsible for setting the scales to give proportions which tests showed were required under the specifications, and after setting the beams the charging box was locked.

The various scales were placed in operation by means of levers projecting through one end of the box. Under this arrangement the man on the charging platform would throw a lever to place the beam for stone in operation and would then admit stone to the charging hopper

until the beam balanced, when the cut off valve was closed. In the same manner cement and sand were added. If through carelessness too much stone or sand was added, a correction was made by means of a plus or minus attachment so that each batch contained the computed amount of cement.

Water was supplied to the mixers from an elevated tank which was provided with an adjustable discharge pipe by means of which the amount of water supplied to the mixer could be regulated or maintained constant. A steam connection was provided by means of which water could be heated in cold weather.

The number of men required for operating the mixing plants was as follows: Operating cement conveyor, 1 man; sand and gravel bins, 3 men; charging mixers, 2 men and operating mixer, 2 men. In addition there was a gang of men who transported cement from storage to dumping pocket.

After being dumped into hopper bottom cars the concrete was hauled or pushed to the forms on a narrow gage track on an overhead trestle, though some concrete was spouted directly into place. A kerosene burning locomotive was used for hauling cars and proved entirely satisfactory.

Costs of plant construction, including equipment for proportioning, are given for the Junction dam plant as follows, based on 1916 prices:

PORTABLE SCREENING PLANT

Labor:	
Framing timbers, 140 hr. at 35c	$49.00
Erecting bins, 1,210 hr. at 35c	423.50
Placing screws and motors, 150 hr. at 35c	52.50
Installing elevator (estimated)	50.00
Total labor	$575.00
Material:	
9,200 ft. B.M. timber at $33	$303.60
3,500 ft. B.M. plank at $24	84.00
1,130 lb. bolts and rods at 6c	68.00
780 lb. sheet metal at 8c	62.40
2 bin gates at $22	44.00
8 track wheels at $20	160.00
2 revolving screens, 42 x 14 in.	1,018.00
1 bucket elevator, 35 ft. centers	830.00
Total material	$2,570.00
Grand total	3,145.00

BINS AND MIXER PLANT

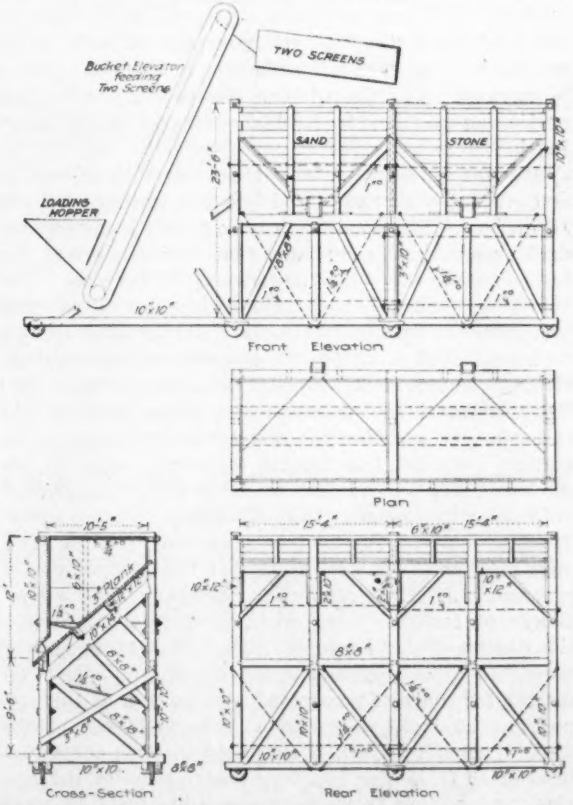
Labor:	
215 hr. framing timbers at 35c	$75.25
1,945 hr. erecting bins at 35c 780 hr. erecting bins at 25c	875.75
120 hr. building house at 35c 60 hr. building house at 25c	57.00
240 hr. setting scales and mixer at 35c 120 hr. setting scales and mixer at 25c	114.00
Concrete footings, 27 cu.yd	28.50
180 hr. heating pipes in bins at 30c 180 hr. heating pipes in bins at 25c	99.00
Elevators and belt converyors (estimated)	200.00
Total labor	$1,458.50
Material:	
Pipe, etc., for heating system	196.00
2,700 lb. sheet steel at 8c	216.00
3,500 lb. bolts and rods at 6c	210.00
4 bin gates at $22	88.00
Concrete for footings	140.00
14,000 ft. B.M. plank at $24	336.00
15,500 ft. B.M. timbers at $33	511.50
Total material	$1,697.50
Equipment:	
71 ft., 18 in., 4-ply belt	400.00
3 No. 4 elevators	2,000.00
2 No. 1618 Standard hopper scales	280.00
2 Mixers	2,300.00
Total equipment	$4,980.00
Grand total	$8,136.00

It should be noted that the above plants are so built that they can be used on future work at slight expense for moving and re-assembling so that the figures given do not represent the amounts to be charged against any one development.

Sand and stone for all three developments were obtained from nearby deposits of bank gravel of which 2% was retained on a 1½-in. screen and 40% on a ¼-in. screen, and 58% passed a ¼-in. screen.

All gravel was excavated by steam shovels or drag line excavators and screened into sand and stone bins using vibrating screens in one plant and revolving screens for the other two. Though the vibrating screens required more repairs than the rotary screens, the results obtained, especially in damp weather, were more satisfactory, as it was found almost impossible to keep the rotary screens from clogging after rains. Portable screening plants were used at two points. Electric power operated belt conveyor and screens.

Cement in cloth sacks was used for the Michigan jobs being unloaded from cars directly into a storage shed having a capacity of 10,000 bbl. and located in close proximity to the mixing plant. Each carload was kept in a separate pile and marked with car number and date received. Bulk cement was considered, but a decision was made in favor of the use of cement in cloth sacks because it was found that it would be easier to obtain the latter from mills within a reasonably short shipping

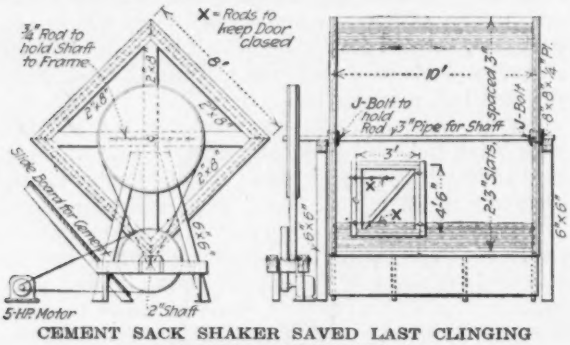


PORTABLE SCREENING PLANT PREPARED PIT GRAVEL FOR EXACT PROPORTIONING

distance. At Wissota dam, however, bulk cement was used with very satisfactory results as to economical handling.

A testing engineer, reporting to the resident engineer, was placed in charge of void tests from which concrete proportions were computed. After setting the scale beams to produce the proper proportions this assistant engineer made frequent inspections to make certain that

mixer attendants used proper care in balancing the scale beams. As all work was being done by the owners, the presence of a concrete inspector at the plant continuously was not considered necessary, but such inspection should ordinarily be provided on contract work. Frequent tests were made of voids in sand and gravel as they arrived at the job and when it was found that void percentages had changed, the mixer scales were re-set without interference with concreting operations. This method of charging the mixer hoppers worked out very well and a much more uniform mixture of concrete was obtained than was possible where proportioning was done by levelling to marks in the charging hopper.



CEMENT SACK SHAKER SAVED LAST CLINGING PARTICLES OF MATERIAL

Samples of concrete were taken from the forms at frequent intervals and poured into 8-in. cylindrical molds 16 in. long. These cylinders were stored in damp sawdust or sand and were later sent to a laboratory for tests of compressive strength when 30 days old. The results of these tests were satisfactory and showed that the methods of proportioning and mixing were such as to insure good concrete. Occasionally a low crushing strength would be shown but it was usually found that this was due to the presence of a stone pocket in the cylinder. In addition to taking sample cylinders for testing, frequent 1:3 briquet tests were made at the job as a check on cement tests made before shipment.

In order to determine the advisability of using waterproofing material in concrete subjected to water pressure a series of tests were made of the permeability of concrete mixed according to different proportions. Blocks of concrete were made, nine different proportions being used. The tests showed that there was no reason to expect seepage under heads up to 50 ft. if mortar for concrete was mixed even as lean as the proportions of $1:2\frac{7}{10}$ by volume. The tightness of the finished concrete which is subjected in some cases to a head of 40 ft. is a satisfactory confirmation of the conclusions resulting from the permeability tests on small samples.

The screening and mixing plants described were used on work involving the mixing and placing of approximately 130,000 cu.yd. of concrete. It has been demonstrated that proportioning by void determination insures excellent concrete with less cement than required to obtain concrete of equal quality with predetermined, fixed proportions. The amount of cement used per cubic yard of concrete ranged from 1.18 to 1.23 bbl. on the several jobs where use was made of the proportioning methods described above. The use of scales for charging the super-hoppers of the mixers was essential to provide for convenience in changing proportions from time to time and furthermore it made almost certain the absolute uniformity of successive batches, since it obviated the difficulty of measuring volumes by bringing the several materials to fixed points in a hopper.

While the quantities of concrete involved are greater than found in the average case, there is no question that void determination and the use of scales would work out very satisfactorily on comparatively small jobs. In cases where it is desired to adhere to the usual method of arbitrarily selecting fixed proportions the use of scales would still be of great value in insuring uniformity of mixture and preventing disputes as to the use of the proper amount of sand, stone or cement.

The details of this system of proportioning and weighing concrete ingredients were first developed by J. D. Justin, resident engineer for the Fargo Engineering Co. at Wissota dam. H. N. Tuley was resident engineer at Junction dam and F. W. Howard was resident engineer at Foote dam, being later succeeded by Holton Cook. The writer is construction engineer with the Fargo Engineering Co. and the mixing plants at Foote dam and Junction dam were designed and built under his direction.

The Railroad Engineer Has a New Opportunity

Protection of the Corporate Interests Is Without Precedent and Calls for Engineering Skill of a High Order

BY FORMER GENERAL MANAGER

PRIMARILY the physical operation of railways is an engineering function. The scientific training of the engineer peculiarly adapts him to solve the various problems entering into the actual operations of transportation systems. The policy of the Pennsylvania R. R. system in selecting the chief operating officials from its engineering staff has resulted in making it one of the greatest transportation systems in the world.

The opportunities afforded the engineer under the Federal operation of the railroads are numerous and manifold, as many new problems have arisen that demand solution. Among these problems are the unification of terminals and other facilities; the rapid extension of existing and the building of new facilities, and the promotion of increased efficiency of present facilities of all kinds. Then, again, the railways during Federal control will be divided into two distinct and separate organizations—one under Federal control, directly concerned in the physical operation; the other, under corporate control, representing the owners of the property.

CORPORATE PROBLEMS UNPRECEDENTED

Each of these organizations will require its proper staff, and on each the engineer will assume a prominent part. The Federal organizations will probably absorb most of the engineering organizations now prevailing on the various railway systems, and perform practically the same duties as under private management,

except that under unified control many new problems will arise not heretofore encountered, such as unification of facilities and modifications necessary to centralized operation and control. The corporate organization, however, will represent an entirely new departure in railway history, and, being without precedent, opens up a wide field of opportunity for the exercise of originality of thought and action.

The function of this organization will be of a character requiring a combination of skill, diplomacy and resourcefulness, not heretofore called for in the operation of railways. The principal duty of the organization should be to see that the rights and interests of the corporation are properly conserved and safeguarded during the time the property is in use by the Government and that it is returned to its owners in substantially the same condition as when taken over by the Federal administration. This function of the corporate interests will demand the closest possible supervision. The Government being merely a tenant and user of the physical property during the period of control, it is essential that the use made of the property shall not affect its value as a going transportation entity, and that its physical condition shall not be depreciated.

Functions of Corporate Engineer

Important elements entering into the problem may be briefly outlined, as follows, all of which call for engineering knowledge and skill and railway operating experience of the highest order:

1. The property should be maintained in substantially as good condition during Federal control as during the "test period"; that is, the three years prior to June 30, 1917. Any depreciation in maintenance of way and equipment the corporate interests should have cognizance of and be able to prove as a basis of claims for reimbursement. If excess expenditures are incurred for maintenance, the Government will likely charge such items to the corporate interests and probably deduct such excess from the rental due for the use of the property.

2. Additions and betterments to the property, if made solely for the purposes of the Government, will likely be paid for by it as operating expenses. Such additions and betterments as are made necessary for the benefit of the property and its efficiency as a normal transportation machine, will be, and properly so, charged to the corporate interests. Fine distinctions will present themselves under this head, and the application of the closest check on all expenditures should be made to safeguard the corporate interests.

3. Federal control will necessarily be exercised in such manner as to serve its purpose, regardless of the individual identity of the various systems or companies. This method of operation will take the form of diversion of traffic from one line to another, and will result in material loss to those carriers which have expended vast sums in perfecting an organization to build up and secure such traffic. The establishment of claims for this loss will call for a high order of operating and traffic experience, as well as a knowledge of the legal phases of the problem.

4. Unification of terminal and other facilities which is now being made and will be extended will call for an adjustment as to the use of the property of one road by another, as obviously it is not within the rights of a tenant to permit another party to use the property of an owner without the latter's consent, nor without proper and aadequate compensation. Many interesting questions will arise, and claims involving careful analysis and supervision to substantiate such claims made thereunder will doubtless be filed for compensation for such use.

5. Determination of proper compensation by the Government for the use of the property will give rise to controversies and claims for damages. Additional rental for property will be sought by the corporate interests to increase such compensation, while the Federal management, on the other hand, will naturally endeavor to offset such claims by every possible charge it can support against the corporate interests. It is therefore important that a proper check be kept by the corporate interests on the operations during the period of Federal control in order that their rights may be fully protected.

6. Finally, at the end of the period of Federal control, it will be incumbent upon the corporate interests to see that the contract obligations are fulfilled—to return the property in substantially as good condition and without impairment of value as a going transportation industry as when such property was taken over by the Federal Government—and to be prepared to require such adjustments to be made as they will be justly entitled to under the terms of the contract and in law and equity.

The importance, therefore, of such an organization to the corporate interests as will enable them to conserve their rights and interests fully cannot be overestimated. As already stated, it will call for engineering and railway operating experience and ability of the highest order, and the engineer possessing such qualifications will be indispensable and in great demand.

Joint Commission Rushes Study of Port of New York

For Present as Well as Post-War Development It Investigates Railways, Steamships, Lightering and Trucking

WAR-TIME activities which make New York the busiest port in the United States if not in the world have not interfered with the work of the New York-New Jersey Port and Harbor Development Commission. On the contrary the newly formed interstate commission is coöperating with the various Federal agencies using New York harbor in the prosecution of the first really comprehensive study of the port, a study which should result in information leading to a scientific development of the port.

The commission, which was formed in the summer of 1917, is now working under an appropriation of $200,000, half of which was supplied by each of the two contributing states. This is supposed to cover the first year's work, and another year at similar cost is expected to complete the preliminary studies. What those studies are have just been outlined in a report of the

commission, from which the following extracts are taken:

In order that no radical changes should be made in the operation of the port, and in order that no construction should be undertaken by the Federal Government under the pressure of the war which might interfere with the general planning of the port, the commission addressed a communication to the Secretary of War, to the Secretary of the Navy, to the Director General of Railroads, and to the chairman of the United States Shipping Board, requesting that before any construction work was done in the port the plans should be submitted to the commission for an expression of opinion as to whether the plans would interfere with the carrying out of a comprehensive port plan. The authorities in Washington readily agreed to this, and there is now scarcely a week that no project is referred to the commission by the authorities in Washington.

The commission is closely coöperating with the Port and Harbor Facilities Commission of the United States Shipping Board, which is investigating all the ports of the United States, and is also closely in touch with the Fuel Administration to coöperate in the working out of a plan to prevent a recurrence of the scarcity of coal of last winter.

Furthermore, the commission is closely in touch with the Railroad Administration, and through the courtesy of the Eastern regional director has obtained the services of a railroad man to aid in its investigation and planning. The regional director has appointed a committee consisting of the managers of all of the trunk lines entering New York, as a point of contact with the commission, and the fullest coöperation has been extended in getting permission to go upon the property of the railroads and to abstract information from the records of the railroads in the field and the auditors' offices.

What Points Are Being Studied

The engineering investigation resolves itself into three phases: (1) Study of existing conditions; (2) analysis of the handling of commerce under existing conditions, and (3) the planning of new methods and new facilities.

The study of existing conditions covers railroad, steamship, lighterage and trucking facilities. Under these investigations the commission decided to send men into the field to make actual observations of the passing of freight, to record all movements of freight and to work out the cost of each of the individual movements.

At first the commission intended to employ outside engineering organizations to conduct these four investigations. This was principally in order to obtain as nearly as possible a simultaneous picture of the operations in the port. When the analysis of what would be needed to conduct simultaneous investigations was finally made, it was determined that this could not be done, owing to the great number of men needed, and the difficulty of instructing these men. As an example, in order to gather a complete picture of railroad operations simultaneously it would take a force of approximately 1000 men.

The commission, therefore, decided that instead of calling on existing engineering organizations, it would organize a field staff which would be large enough to cover 24 hours at each point to be investigated. A force of 25 men was formed rapidly, detailed instructions were given them and they are now at work taking 24-hour observations of the detailed railroad operations at all of the yards and pier stations. This force, after it has concluded its observations at all of the railroad yards and pier stations, will probably be assigned to one of the other investigations, as, for instance, trucking. The value of having a continuing force is that it is becoming increasingly familiar with the character of the information needed, and a great deal of time is saved over what would be required to instruct four individual organizations.

One of the special values of this railroad study will be in the comparison of the operation of the different railroads and in the aid it will give to the allocation of costs of the different movements. The records of the railroads will give certain costs in detail, but it will be necessary to subdivide these costs further than the books show, and for this purpose the observations in the field will be of great value.

A party has been placed in the field to locate an exterior belt-line railroad in New Jersey. The necessity for such a railroad is widely recognized, and officials in Washington have expressed their opinion that it is a war measure. The commission has set aside a sum of money which it believes will be sufficient to locate such a railroad, and expects to be in position to advise the Federal Government that the line is surveyed and located and ready for construction.

The commission has taken up with the Public Service Commission for the First District of New York the matter of the west side Manhattan railroad tracks, and the engineering departments of the two commissions have come to an agreement on the general physical plans. It is believed that the two commissions themselves will come to an agreement upon not only the physical plans but also upon a method of procedure, and when this is done the matter of the west side tracks and the New York Central surface tracks will be taken up by the commissions and prosecuted vigorously with a view to settling this long controversy.

The commission has a list of some 400 warehouses and storehouses in New York and in New Jersey within the metropolitan district, and is sending out a questionnaire in order to determine what facilities exist, and get full information as to their operation.

Warehousing and Trucking to Be Studied

An investigation has been started into the operation of lighterage, with a view to obtaining all existing information that is available prior to the actual observations of the field force. A further investigation has been undertaken into the markets and food distribution, and the commission is collecting all information available on the subject as to the operation of public and private markets with a view to following this up to obtain the groundwork for a recommendation as to methods and facilities needed to modernize the food distribution of New York.

Trucking conditions will be looked into especially to determine the trucking delays, costs, etc., at this time in order to compare them with operations under the proposed modified form of store-door delivery which is

soon to be put in force at the port. This investigation will not cover an elaborate checking in the field of trucking delays, but will take up certain physical routes and certain typical movements, and will give certain information which will be of value when the commission comes to the actual checking in the field by the field force.

Further studies are being made in regard to the electric power situation at New York. This includes listing of the various power houses throughout the port, and their development and reserve.

Facilities for the interchange of commerce on the New York State Barge Canal are being examined. The terminals in the harbor, with their description, which have been built and which are contemplated will be studied, and general details will be prepared for additional terminals. All of these are within the state of New York and funds for their creation have been supplied by the state. Certain locations are now available in New Jersey, where good interchange of commodities can be had between railroads and the vessels operating on the Barge Canal.

Among other investigations to be taken up are a study of banking and commercial relations in financing New York's commerce, methods of handling express business, the operation of private terminal companies, the handling of fuel and grain, the pollution of the harbor and the mechanical equipment of the port structures.

The engineering office of the commission, at 14 John St., New York City, is under the direction of B. F. Cresson, Jr., consulting engineer.

Bridge at Lyons Named in Honor of President Wilson

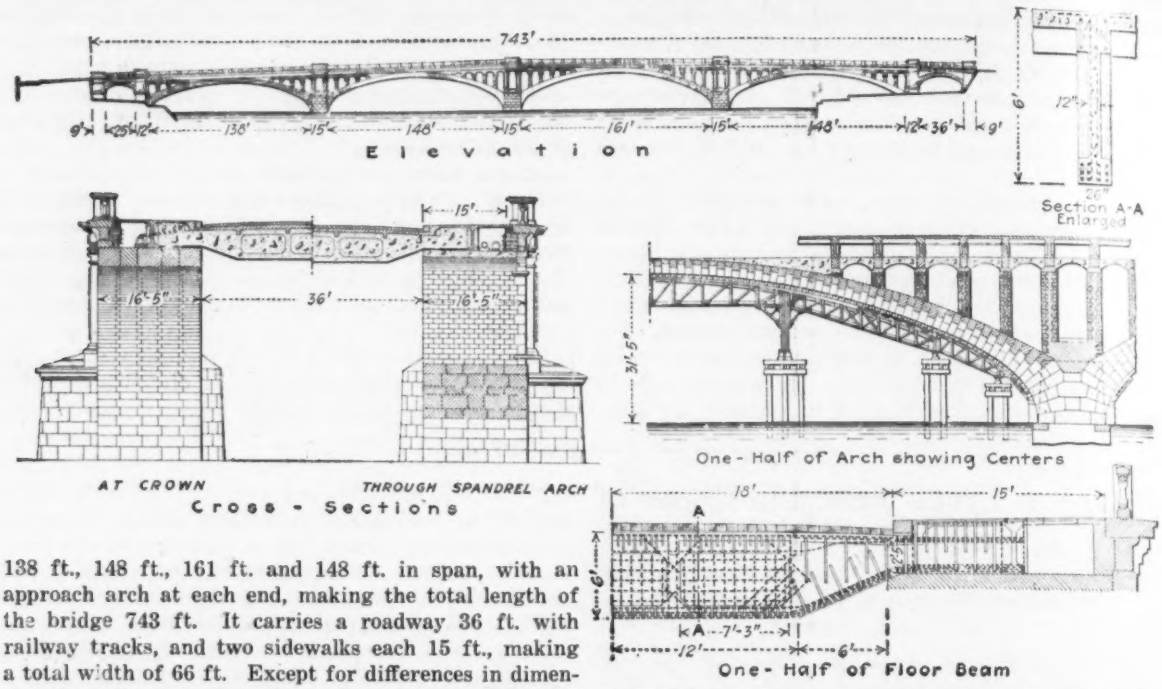
Arch Structure with Twin Masonry Ribs Carrying Reinforced-Concrete Floor Peculiar to French Design

BASTILLE Day this year was celebrated in Lyons, France, by the dedication of a new masonry arch bridge, across the River Rhone, to which has been given the name Pont Wilson in honor of the President of the United States. Aside from this grateful act on the part of the municipality of Lyons, which built the bridge, it should interest American engineers because it is the latest example of a French type of bridge that combines all of the recognized architectural qualities of the stone arch with many of the structural advantages of the reinforced-concrete floor. The bridge is noteworthy, too, because it has been carried to successful construction through the past four years of war.

Lyons, like Paris, has many bridges, crossing both the Saone and the Rhone Rivers, which run through the city. The latest bridge occupies the site of an old suspension bridge built in 1839. This bridge was taken down in 1913 and replaced temporarily with an adjoining wooden trestle bridge which carried the street traffic during the past five years. Work was started on the foundation of the new Wilson bridge in October, 1912, and rapid progress was made until the outbreak of the war. Since then construction has been steady but slow. The bridge was opened, as stated, on July 14, of this year.

The Wilson bridge consists of four elliptical arches,

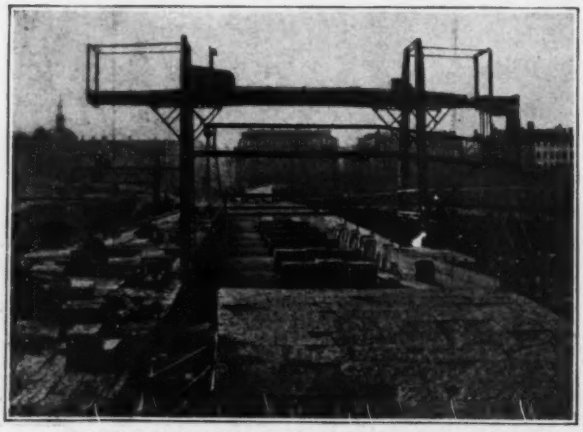
PROCESSION OVER THE WILSON BRIDGE, AT LYONS, FRANCE, ON ITS DEDICATION DAY, JULY 14, 1918



NEW BRIDGE AT LYONS, FRANCE, HAS MASONRY TWIN ARCHES WITH CONCRETE FLOOR SYSTEM

138 ft., 148 ft., 161 ft. and 148 ft. in span, with an approach arch at each end, making the total length of the bridge 743 ft. It carries a roadway 36 ft. with railway tracks, and two sidewalks each 15 ft., making a total width of 66 ft. Except for differences in dimension the arches are all similar, each arch being composed of two independent ribs, 16½ ft. wide and 36 ft. apart, resting on independent piers which extend down to a common pier footing. While the piers and the arch ribs are of cut stone, they carry a reinforced-concrete roadway on cut-stone spandrel piers, which are braced longitudinally by continuous concrete jack arches. The concrete fill also extends from the last spandrel pier, about over the haunch, to the crown. These jack arches have cut-stone fascia arches on the outside walls of the arch ribs.

The floor system comprises floor-beams at each spandrel pier spanning the twin ribs and carrying a reinforced-concrete floor. These floor-beams, which rest on the concrete fill near the crown and on the spandrel piers for the remainder of the arch, are deeper between the arches than they are at their supports on the ribs. They are heavily reinforced, as shown in the drawing, and have panels of concrete removed from the shaft of the beam between the stringers of the floor, to save weight. The floor itself is a slab 3½ in. thick spanning between 8 x 18-in. longitudinal stringers framing into the floor-beams over the full-thickness sections—that is, above the shafts in the paneling. The roadway itself is of creosoted block, while the sidewalks are of asphalt. An ornamental railing of cut stone finishes the architectural appearance.



TRAVELING GANTRY USED TO SET STONE ON RHONE BRIDGE

Arches Built on Steel Centers

Except for difficulties in getting labor and material during war times, there were no extraordinary incidents in the construction. The foundations were put in under compressed air in the sand-and-gravel bottom of the Rhone. The formation here had been made quite familiar by previous construction, and no difficulty was experienced in sinking the caissons to the necessary depth of 30 to 40 ft. The arches, which were of different lengths on account of the channel necessity, are built on steel centers supported from six timber pile platforms in the river. Variations in the blocking under the lagging permitted the use of the same forms on all four arches. They were lowered by sand boxes on platforms. Arch ribs were set up in two rows of stone at the crown and three at the springing line, and staggered in plan to guarantee bond. The loadings were spaced along the arch ribs so as to insure the least deflection in the centering. Control of all the stone-setting and concreting operations was had from a gantry crane which traveled on tracks running on each side of each arch rib.

The bridge was built by force account under the direction of M. Chalumeau, chief engineer of the City of Lyons. Its total cost amounts to about 2,150,000 francs, or $430,000. A description of the bridge, from which many of the above figures are taken, appeared in *Le Génie Civil* for July 13, 1918.

Americans Build Sewer and Water Systems for Three Uruguayan Cities

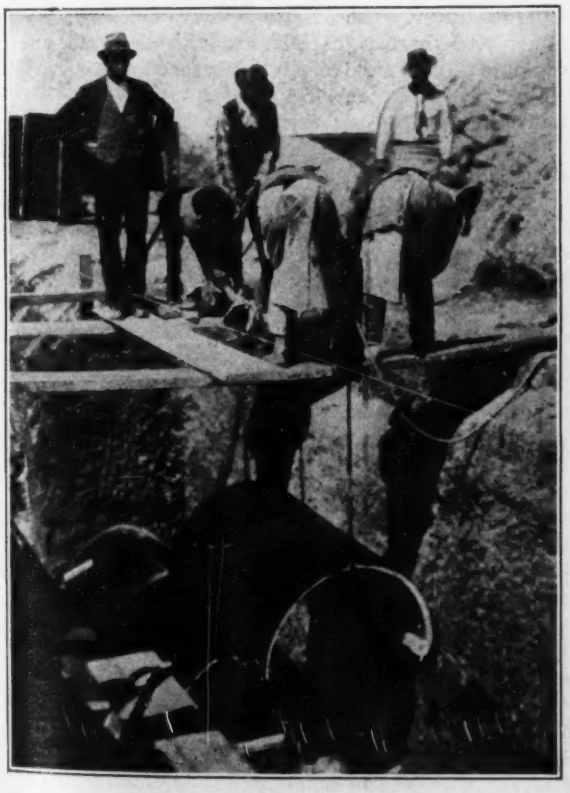
Work Requiring Five Shiploads of Materials 7,000 Miles From the Base of Supplies Completed Year Ahead of Time—Cement Pipe Manufactured on the Ground

BY ALBERT A. NORTHROP
Hog Island, Pa.

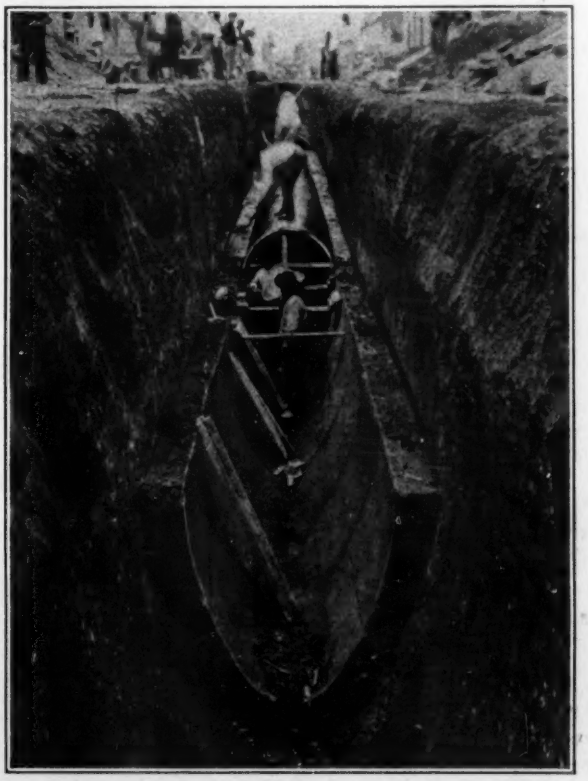
IN spite of the handicap of war times and of carrying on the construction operations so far from the base of supplies that it took two months or more to get repair parts by water, the Ulen Contracting Co. of Chicago has just finished three complete water supply and sewerage systems for the government of Uruguay a year ahead of schedule. Except for the cement, which was made in Montevideo, all the construction equipment and materials had to come ten thousand miles by water from Savannah, Ga. Because of the difficulty of shipping clay sewer tile, cement tile was manufactured at a plant set up at each of the three cities in turn. The construction was carried out with local labor, which proved very efficient, under American supervision.

The improvements, which were financed by the progressive National Government of Uruguay, consisted of a filtered water supply and a sewerage system for each of the cities of Salto, Paysandu and Mercedes. Next to Montevideo, these are the three largest cities of the republic, having populations ranging from 16,000 to 25,000. They are located in the same relative latitudes as Charleston or San Diego, and are as far south as Cape Town, South Africa. Salto and Paysandu are on the River Uruguay and Mercedes is on the Rio Negro. Each has an abundant water supply right at its door, but heretofore water has only been available as it was peddled from house to house in two-wheeled carts. Cisterns were also used, but in a region where the rainfall hardly exceeds 32 in. a year, these cannot be relied on as the main source of supply. Wells, used extensively by the poorer classes, helped supply typhoid fever as well as water.

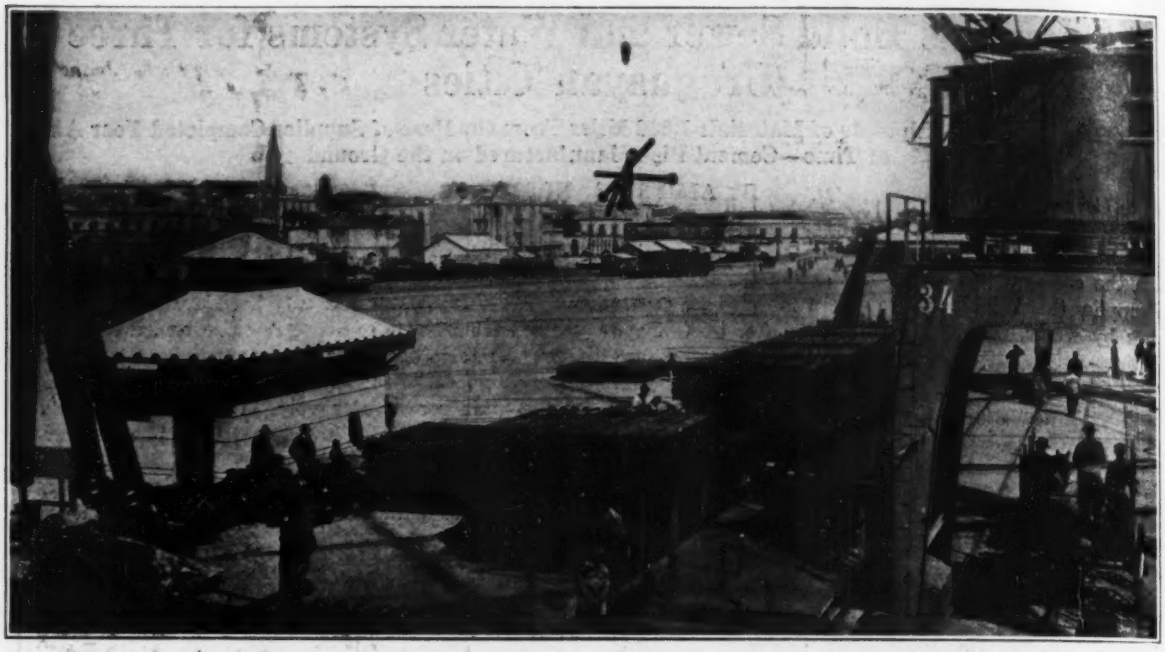
The water system in each town consists of low and high pressure pumps in duplicate with a capacity of 1543 gal. per minute. Rapid sand filters with an equal capacity were designed on the assumption that they would pass 120,000,000 gallons per acre per day. Two steel stand pipes 20 and 30 ft. in diameter respectively and 100 ft. high act as storage and pressure tanks for Salto. A similar set was built for Paysandu, but at Mercedes there was a conveniently located hill of sufficient height to make possible a covered concrete reservoir. A few of the hydrants installed resemble those in the United States, but have in addition a service valve from



SECTIONAL ARCH FORMS USED



LOWER HALF OF EGG-SHAPED CONCRETE SEWERS CAST AGAINST TRENCH SIDES



CAST-IRON PIPE ARRIVES IN MONTEVIDEO AFTER A 10,000 MILE VOYAGE

which water can be drawn for horses. All other hydrants are set flush with the sidewalk and covered with an iron plate, as is usual in Uruguay.

The sewerage systems provide for the removal of storm water as well as sewage. Up to the 22-in. size the pipe was precast. Larger sized sewers were built of concrete poured in place, being circular to a diameter of 40 in. and egg shaped above that size. Sewage is discharged directly into the rivers well below the towns. Disposal plants are not necessary because of the very high dilution and the scarcity of population for many miles down stream.

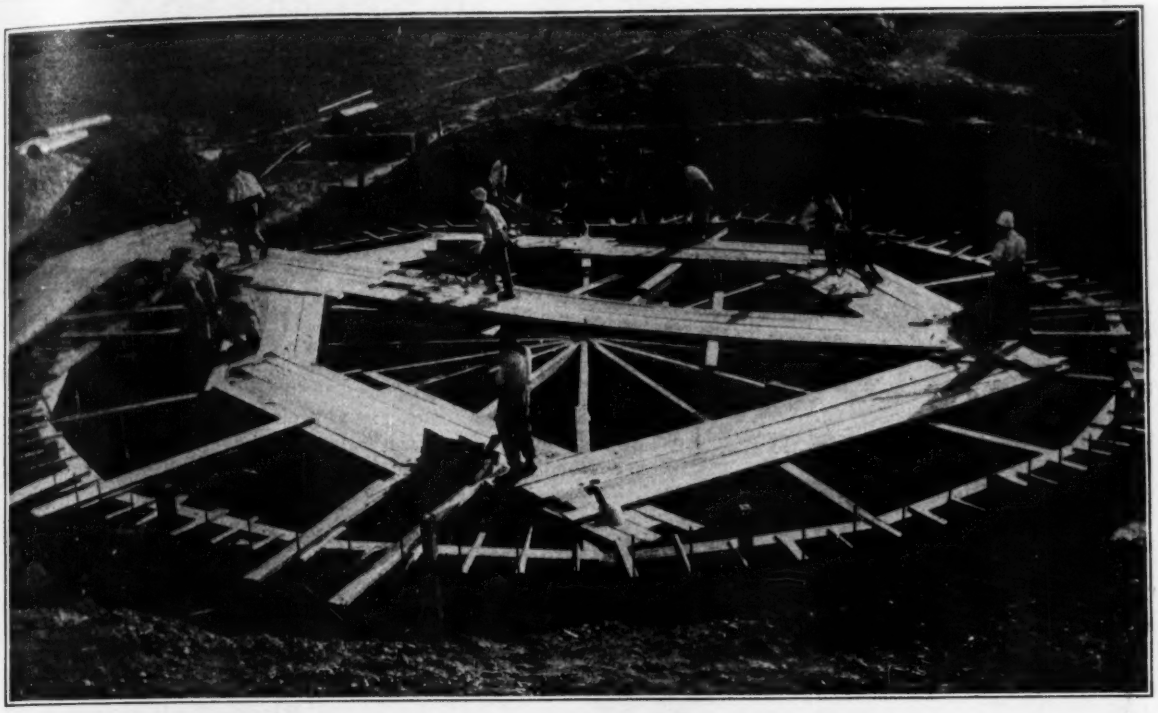
WORK DIVIDED BETWEEN THREE CHIEF CITIES OUTSIDE OF CAPITOL

Five ship loads of plant and materials were carried from Savannah, Ga., to the River Plata, at the mouth of which Montevideo is located, the average voyage taking about 80 days. One of the schooners drawing 24 ft. of water delivered 2000 tons of cast-iron pipe directly alongside the wharf at Paysandu, 300 miles up the Uruguay River. The other four were unloaded in the $25,000,000 harbor of Montevideo, which is fully equipped with electric cranes, telpherage systems and all modern appliances for the rapid discharge of freight. Railroad lines run directly on the dock front so that little English "wagons" were loaded in one operation from ship to car. The cast-iron pipe piled high in them was held on by means of chains.

Most of the railroads, having been built by British capital, look very English. Locomotives usually burn briquettes of Cardiff coal. This has now advanced to $40 per ton and is scarce at that price, so that the heavy wood called "quebracho," or "break-axe," is extensively used for fuel. It makes an excellent substitute.

Some 13,000 tons of cement were used in the work, all of which was made in Uruguay in an up-to-date plant manufacturing an excellent product. It is sold net without charge for the sacks, but the customer must pay 6 cents apiece for those lost or damaged. The industry is protected and the cement sold a little under the import price. Owing to the extremely high price of coal, cement has risen until it costs from $8 to $10 per barrel. In normal times it cost about $3.50.

Sand and gravel were dredged from the Uruguay River with a maximum haul of 100 miles. Both were of excellent quality, composed almost entirely of agate quartz, brilliant in coloring and of great hardness. In fact, it is from the vicinity of Salto that before the war large quantities of agate were exported to Germany, where a considerable industry was maintained in polishing it for sale.



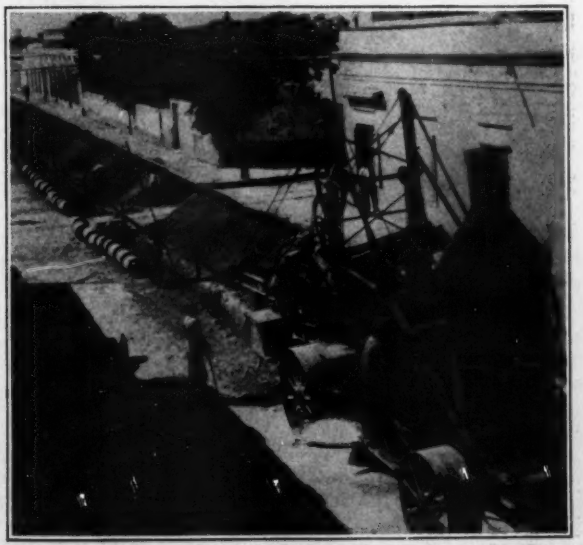
FORMS READY FOR CONCRETE AT SALTO CLEAR WATER RESERVOIR

The manufacture of sewer pipe on the ground proved very satisfactory. Under government test the pipe showed a bursting pressure of 61 lb. per sq.in., and a crushing strength, supported only at top and bottom, of well over 2 tons per sq.in. The pipe was made by a MacCracken machine, which is rotary packer of very quick action. Horizontal blades on a rotating shaft moving at high speed pack the mortar inside the mould, which is a steel form in two halves, set bell down for casting. A cement and sand mixture containing only sufficient water for proper setting is dropped into the top of the form on the blades, which revolve so rapidly that none of it can fall through. The blades travel from bottom to top, and leave an almost glazed finish on the inside of the pipe. On the 6-in. size the average for the day frequently equals a pipe every 40 sec. When 3 shifts were put on, the Uruguayans' sporting blood was aroused and keen rivalry developed. One night a small riot broke out because the graveyard shift, eager to begin, claimed that the others were working overtime to help their record.

After being cast, pipe and mould were picked up by a two-wheeled "sulky," turned end for end and sent out to the covered storage yard, where the forms were removed after a few hours and the pipe left to cure. The cement pipe plant was set up at each of the three cities in turn far enough in advance of the trench excavation to have the pipe completed before the work was ready for laying.

The excavating equipment consisted of two trench machines and a 35-ton revolving shovel with an extra long boom for trench work. The steam shovel, on account of the heavy freight charges on it and the enormous cost of fuel, proved hardly able to compete with hand labor in the trench work. However, this shovel was fitted with a boom and used as a locomotive crane during unloading periods. The trench work was laid off in "tasks" of such length as to include a volume of 5 meters, which was a day's work and the basis of a day's pay. Each laborer took a section, and when he completed it could quit for the day or have another one assigned him. Six and one-half yards per day per man may seem a good high average, but the star member of the excavating forces on one occasion completed three of these tasks in one day, earning thereby the proud title of "Little Marion."

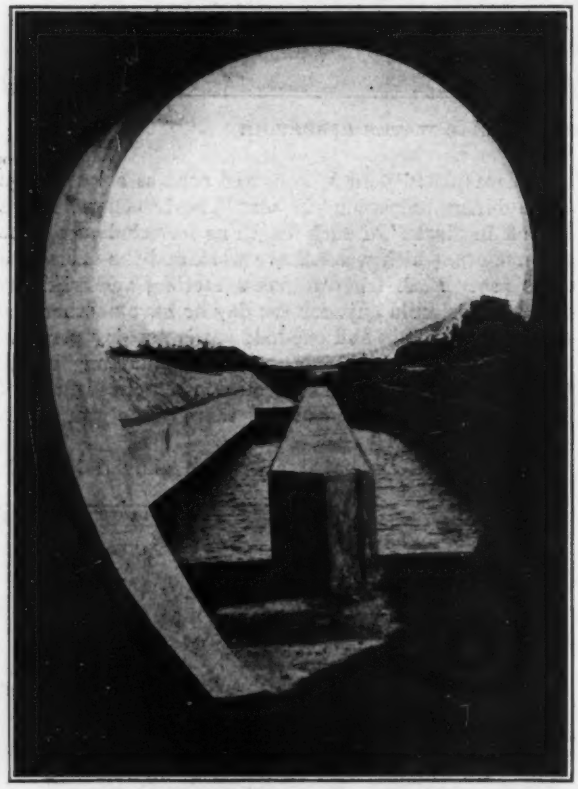
The material excavated above the alluvial lowlands



TRENCHING MACHINE USED IN LAYING LARGE MILEAGE OF SEWER PIPE

near the rivers was either largely gray clay, or "tosca." Rock was encountered, but the other materials predominated. "Tosca" is sometimes translated "rotten rock," but it is often far from rotten. It is as general a term as hardpan, and quite as indefinite. The contractor accurately described it by saying "When you are losing money, it's tosca, and when you are making money, it ain't." It appears to be a sandstone conglomerate held together by a crystalline cementing material. It is in effect a concrete, varying in hardness and composition just as cement concrete does between "initial set and 90 days," depending upon its depth from the surface.

Trench and form lumber was largely Brazilian pine, which, though not so good as northern pine, is comparatively free from knots and answers very well. Quebracho piles from Paraguay were used to support the sewer outlets. This wood cannot be excelled where resistance to decay is required and where unusual weight is not objectionable. It is a dark red wood, 1 1-3 times as heavy as water, and very rich in tannic acid used in tanning leather. The extract is exported in large quantities. As a railroad tie the life of this



CONSIDERABLE YARDAGE IN CONCRETE SEWER OUTFALL AT PAYSANDU

wood is only limited by its capacity to receive spike holes, which must be bored into it because of its hardness. The chief engineer of the Paraguay Railroad tore down a stockade of quebracho built 90 years ago as a protection against hostile Indians and used the posts for a right-of-way fence. They were still in excellent condition. The tree is of slow growth and very crooked, straight piles rarely exceeding 15 ft. in length.

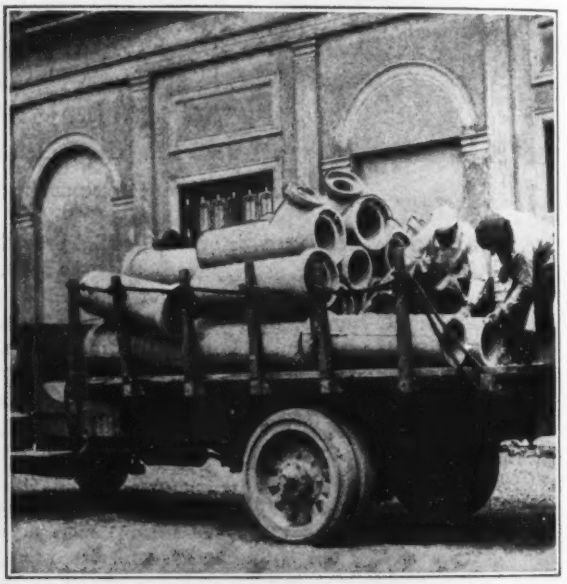
The work was carried forward continuously notwithstanding the ever rising freight rates and the difficulty of securing ocean carriers.

Actual construction work was begun in August, 1916, and finished in December, 1917.

Salto, the city containing the most rock and farthest from headquarters, was started first, the others following just as soon as the cement pipe machine could be moved to them.

A Blystone mixer of the troweling type was used with satisfactory results for the pipe machine. For the monolithic concrete the usual drum type mixer was used, the best results being obtained by frequent shifting of the mixer and chuting direct into the trench.

Quite often hand mixing was resorted to, in which case two mixing boards were used, one being charged while on the other the material was being turned over. It was difficult at first to keep the men



CONCRETE PIPE DISTRIBUTED FROM PIPE PLANT TO TRENCH BY MOTOR TRUCK

from working in the concrete in bare feet. They soon learned the error of their ways, however!

Exceedingly fair treatment was accorded by the Uruguayan government, of which Señor Rivas is Minister of Public Works. Señor Pedro B. Magnou was engineer in charge of the work. The contract was carried out by the Ulen Contracting Co. of Chicago, of which Henry C. Ulen is president. Thomas Shepperd, vice-president and general manager, was in charge of the job on the ground. Earl Ulen was office manager; Edward Trueheart, chief engineer, and Señor Alberto F. Canessa, consulting engineer. The field superintendents for each of the three cities were respectively, Herbert Hengst, Merton Keefe and Thomas Caldwell. Stone & Webster and the American International Corporation were associated with the contractor on the work, being represented by the writer.

Heavy Construction Hauling Practice Modified by War Conditions

Hiring of Private Trucks by the General Contractor Superseded by Subletting to Haulage Contractor Who Maintains Operating and Repair Force—General Contractor Loads Trucks and Maintains Roads

By George H. Pride
President of the Heavy Haulage Company, New York City

HEAVY construction hauling has been revolutionized during the past year by the many problems resulting from the building of large cantonments and war manufacturing establishments. Thinly as well as densely distributed hauling over the sites of many such contracts has shown that the use of the motor truck can be economical, even when used for short hauls within limited areas. On a typical job, by intelligent management and the use of well-selected and easily transported mechanical appliances for unloading cars and loading trucks, one firm of general contractors saved more than 25% of what it would have cost to haul the material by teams, or industrial roads combined with teams.

The meaning of thinly distributed hauling is amply illustrated by conditions at cantonments, which require large volumes of material to be distributed more or less uniformly, in comparatively small volume, over a very wide area. By densely distributed hauling is meant the delivery in small areas of large volumes of construction material, such as the materials required for very heavy concrete foundations for large structures. In the first instance, the motor truck must compete successfully with the horse, and in the second instance, the motor truck must excel the temporary standard-gage or industrial railroad.

Within the past year there have been several operations where the motor truck has successfully competed with both of these forms of transportation. Thus, abnormal transportation conditions due to the war, combined with the necessity for speed, led to intensive study of haulage problems. New methods of handling and transporting were tried out; changes in the contract system, whereby the haulage was let by sub-contract, were made, and higher efficiency has resulted.

The transportation contract, as described herein, has developed through many stages. At the beginning of war construction last year, it became the custom of general contractors to hire motor trucks at a stated price per day, agreeing to furnish the gasoline and oil, maintain the trucks in repair and return them to the owners at the ends of the contracts in as good condition as when received, barring reasonable depreciation. The general contractors undertook to employ and pay, through their own employment departments, the chauffeurs necessary to run the trucks. Such a rental contract proved unsatisfactory, because it was more attractive to the owner of trucks in poor condition than to those who had trucks in good condition, and high maintenance charges resulted.

In the second phase, some of the general contractors bought their own trucks, but as the greater portion of the large number of vehicles necessary are required for only a short period, the general tractor soon had a heavy investment tied up in motor trucks of questionable salvage value at the end of the contract.

The third phase of the practice developed renting trucks from owners at a stated price per day, the general contractor furnishing the gasoline and oil, and paying the salaries of the chauffeurs, but requiring the owners of the trucks to maintain them in working condition, make all necessary mechanical repairs, furnish tires as required and also to supply the necessary chauffeurs. When a truck was out of service from mechanical defects or absence of the driver, the owner was not compensated for such time as it was idle.

In the fourth phase the general contractor, instead of making individual agreements with numerous truck owners, made an agreement with one truck owner for the entire number of vehicles required. The latter could sublet or own them as he saw fit, but was under obligations to furnish the general contractor with the necessary number of trucks at all times.

Through the fifth and latest form of contract the general contractor bargains with a motor transportation company to supply the necessary motor trucks for the prompt execution of the contract. It requires the transportation company to furnish the necessary shop facilities for repairs—with the exception of the building, which is provided by the general contractor—and to maintain an adequate supply of parts, so that there may be no unnecessary delay in repairing trucks. The transportation company must also maintain, at its own expense, a competent master mechanic, a sufficient force of mechanics to make repairs, an office man to keep records and an operating superintendent. It is required that all trucks be of the same make and all must be owned by the haulage contractor. It is further stipulated that, although the chauffeurs are paid on a scale determined by the general contractor, which scale can be modified as labor conditions require, the transportation company must furnish to the employment department of the general contractor a sufficient number of skilled chauffeurs to man the trucks. If any of the trucks are idle, owing to lack of drivers, the transportation company is not paid for them.

As in the previous forms of contract, the general contractor agrees to furnish the necessary gasoline and oil, and this is taken into consideration in the rental price. The transportation company is compensated at a stated price per truck per day, being allowed straight time for any overtime or Sunday work. Ordinary delays, such as would occur in regular running, are not deducted from the time of the trucks, but should any truck be out of service for mechanical repairs or adjustment for a period in excess of 30 min., the entire time that it is idle is deducted from its day's earnings. All loading, and unloading, where material cannot be dumped, is done by the forces of the general contractor.

Under this form of contract the general contractor knows exactly what his transportation units will cost per day, before the operation is started. His purchasing

department has none of the worry or bother of getting the multitude of small parts necessary to keep the trucks in operation. As the contract stipulates that all the motor trucks shall be of the same make and that they shall all be owned by the transportation company, it is obvious that a higher degree of working efficiency can be maintained.

Under this last form of contract, it is evident that the transportation company supplies a transportation service to the general contractor, rather than merely a number of rented trucks. Having no responsibility for the trucks or their operation, with the exception of routing them to the various points where transportation is required, he can direct all his energy toward promptly loading and unloading them.

A contract of this type has been entered into by the Heavy Haulage Co., of New York, which is furnishing the transportation for one of the large war munitions plants being built for the Government. The magnitude of the operation is indicated by the following items: Material for 150,000 cu.yd. of concrete; 28,000,000 bricks; 72,000,000 ft. of lumber; materials for more than 40 miles of macadamized road; and several thousand tons of machinery. In addition to the above the hauling includes all the household furniture, commissary, electrical, mechanical and sanitary supplies, ice, pipe, etc., required for building the plant and housing for the many employees. The area covered by the operation has railroad sidings so distributed that the average haul is ½ mile.

To handle this traffic 50 five-ton motor trucks, divided between those having hydraulic-hoist dump boxes and those of the platform and rack type, were purchased. All material not fragile, such as stone, sand, brick, and in some cases cement, is dumped. Other freight, such as tile, machinery and electrical apparatus, which are hauled upon platform trucks, is unloaded by hand.

Mechanical apparatus for unloading stone and sand from the cars to the stock piles is used by the general contractor. Self-propelling loaders convey the material from stock piles to the tracks. Heavy pieces are loaded on the trucks by derricks and cranes. Merchandise, and light and fragile pieces, are loaded by hand.

Care was taken to house the organization properly. It consists of a superintendent, an assistant superintendent, a master mechanic with his assistant, mechanics and helpers, and the truck drivers. A comfortable building was provided by the general contractor, giving about 50 ft. of floor space to each man and having modern conveniences and a shower bath for every six men. The men take their meals at the eating houses for the employees on the general contract. Under these conditions, the subcontractor having his own organization, which assures his men of steady employment, is able to hold them, a thing difficult under the old system.

When hauling commenced, the great problem was the condition of the roads. The soil was clay and when dry made an excellent roadway; in wet weather, however, the roads were almost impassable. At a conference between the general and the haulage contractor it was concluded that proper drainage, with some repairing of the bad places, would amply repay all concerned, and a regular system of drainage and maintenance was established by the general contractor, who thereafter kept the roads in condition. The maintenance consisted in keeping the drainage open, filling up chuck holes with gravel, and, in places, building stretches of plank road. After this was done the trucks were operated over the dirt roads with a time efficiency of 90 per cent.

The operation of this fleet has established new records. While it had always been assumed that over ordinary roads for hauls averaging ½ mile teams would be more economical, it was found that the trucks, in conjunction with the mechanical loading apparatus, effected a saving of from 25 to 30 per cent. The speed of the trucks was one of the main factors. In one instance a truck handled 60 loads of material in a 10-hour day, while the average number of loads of stone and sand per truck has been in excess of 30 per day. The number of railway cars unloaded per 10-hour day has been about three hundred. It is estimated that one truck will do as much as four teams, and in one case a truck did as much as 10 teams.

With reasonably good earth roads the motor truck will handle material with maximum efficiency and speed. This, however, can only be done where every mechanical means is used to facilitate the loading and unloading of trucks. The transportation charges, which are such a large item on a job of this character, are greatly reduced, and the system assures the general contractor of prompt delivery and consequent freedom from delays.

Water Terminals Subject of Federal Report

New River and Harbor Act Requires Full Details on Ohio River and on Harbor Projects

IN THE rivers and harbors act just signed by the President, provision is made for the development of river and harbor terminals and transportation communications between water and rail. In the paragraph authorizing the continuance of work on the Ohio River the Secretary of War is requested to investigate and submit to Congress before December, 1918, a report showing the status of water terminals at cities and towns along the river between Pittsburgh and Cairo, whether owned by municipalities or some other public agency, and whether they are satisfactory as to location, construction and equipment. The report is also to furnish the names of cities and towns where an interchange of traffic exists between the water transportation lines and the railroads, a list of all the transportation lines on the Ohio, with a description of equipment, names of cities and towns where no adequate public terminals exist, together with a statement of prospective plans for such terminals, and finally any recommendation for the development of transportation on the river.

As a general clause in the act, the Chief of Engineers is required to indicate in his annual report the character of the terminal facilities existing in every harbor or waterway under maintenance or improvement by the United States. He must also state whether they are considered adequate for existing commerce. He must submit special reports on this subject as soon as possible, including among other things the following:

1. A brief description of such water terminals, including location and the suitability of such terminals to the existing traffic conditions, and whether such termi-

nals are publicly or privately owned, and the terms and conditions under which they may be subjected to public use.

2. Whether such water terminals are connected by a belt or spur line of railroad with all the railroads serving the same territory or municipality, and whether such connecting railroad is owned by the public and the conditions upon which the same may be used, and also whether there is an interchange of traffic between the water carriers and the railroad or railroads as to such traffic which is carried partly by rail and partly by water to its destination, and also whether improved and adequate highways have been constructed connecting such water terminal with the other lines of highways.

3. If no water terminals have been constructed by the municipality or other existing public agency there shall be included in his report an expression of opinion in general terms as to the necessity, number, and appropriate location of such a terminal or terminals.

4. An investigation of the general subject of water terminals, with descriptions and general plans of terminals of appropriate types and construction for the harbors and waterways of the United States suitable for various commercial purposes and adapted to the varying conditions of tides, floods, and other physical characteristics.

Piezometers and Current Meters Used to Test Wells

Flow Records Obtained and Leaky Casings Located as Part of Water Conservation Program at Honolulu

By R. D. Klise

Assistant Engineer, Division of Hydrography, Territory of Hawaii, Honolulu

CONSERVATION of artesian waters throughout Hawaii and particularly within the city of Honolulu is receiving careful attention from the territorial and municipal governments. Besides territorial investigation and legislation the city named is doing practical work to detect and control waste. This work includes tests of well flows and location of defective casings by means of the piezometer and the current meter, followed by repairs of the casings.

As the result of a thorough investigation and report by the water commission of the territory to the governor of Hawaii, the 1917 territorial legislature adopted as law "an act relating to the use of water from artesian wells." Though applicable to the use of water in any part of the territory, this law has particular significance to the use of water from the wells within the city limits of Honolulu, because it is from the artesian basins underlying the city that the water-works department obtains 80% of all water passing through the city mains, and there is no other source of supply to which we may turn when these artesian basins are exhausted.

What the New Law Provides

Briefly stated, the new law provides a more or less general definition of what constitutes waste of artesian water for irrigation purposes, and a specific definition of underground waste. It prohibits the use of artesian water solely for the purpose of driving machinery, obliges people sinking new wells to submit an accurate log of the boring to the Government, and compels all well owners to see that their wells are properly capped and cased. The violation of any of the provisions of this law constitutes a misdemeanor, and for each offense the guilty party may be fined not more than $50.

The act proposed by the commission in its report to the governor also recommended that the owners of private wells should be allowed to use them for garden and irrigation purposes only during the same hours as is prescribed by the water-works department for the people who obtain water for like purposes from the city mains (4 hours per day). The commission took the

CURRENT METERS ARE USED TO LOCATE DEFECTS IN ARTESIAN WELL CASINGS

stand that its report amply proved that in Honolulu all the wells of the various districts are drawing from the same artesian basins, and that these basins are fast being depleted. The artesian head is now 30 ft. above mean sea level, whereas originally it was approximately 42 feet.

143 Artesian Wells in City

There are 143 artesian wells within the city limits of Honolulu. Of this number 125 are owned privately, four belong to the territory and the remaining 14 are owned and operated by the water-works department. These wells vary in size from 4 to 12 in. in diameter. Nearly all wells bored in the past 25 years have been 10

and 12 in. in diameter. The average diameter for all wells bored in Honolulu is approximately 9 inches.

To obtain a continuous record of the artesian head in each basin, a number of wells known to be in good condition are equipped with piezometer tubes so that the height to which the water rises may be quickly and accurately ascertained. The head on wells so equipped is read at least once a month, and on two of these wells daily records are kept by the engineers in charge of the industrial plants operating the wells.

The piezometers consist of short sections of ½-in. galvanized-iron pipe terminating in a sleeve fitted with a plug. A small glass tube that will fit into this sleeve is carried by the observer, who goes from well to well and measures the height of water above an established bench mark conveniently located for that purpose. The wells in Honolulu have been tied in by accurate levels, and it has been found that for all the wells in any particular basin the artesian head is the same. When the head on any particular well shows as much as 2 or 3 ft. below the standard head for that basin the presumption is that the casing has failed, and if possible the well is tested by a current meter.

Current-Meter Test

This test is simply an effort to determine velocity, and if successful will show not only the amount of flow but the approximate locality of the break in the casing. In the case of flowing wells it is first necessary to close all valves and carry the casing up to such an elevation that the water will not overflow. Any type of current meter with suitable telephone connections may then be utilized for the velocity measurement by lowering it into the well and "listening in" on the telephone. The small-size Price current meter makes a very good instrument for use on wells above 8 in. in diameter, and a smaller type of the same instrument could undoubtedly be turned out that could be used inside of casings of 6 in., or even 4 in. diameter. It is necessary, of course, to protect the cups of the meter from the sides of the casing and on the bottom.

On the meter originally equipped for this purpose the writer has used three additional yokes made of No. 6 galvanized-iron wire. These wire yokes are riveted to small collars bent to fit evenly around the upper and lower arms of the regular meter yoke, to which the collars are securely fixed by means of small bolts. The meter is raised and lowered with a plunger rod made of ¾-in. galvanized-iron pipe in 10-ft. sections. The sections are joined together as the meter is lowered into the well. Three men and the observer can readily handle 400 ft. of this pipe, and by using tee connections which permit the insertion of a short nipple for the purpose of hanging the pipe over the top of the casing while adding an additional section, as much as 500 or 600 ft. can be handled without any great difficulty. A rigid plunger rod enables the observer to make slight changes in the position of his meter, prevents surging of the instrument at high velocities and gives reasonable assurance that the instrument can be safely recovered.

Telephone connection with the meter is obtained through a double line of No. 18 insulated copper wire having a length of 1000 ft. and carefully reeled on a 14-in. spool conveniently mounted for operating. To insure good contact the cable is first firmly secured to the section of the plunger rod connecting directly to the meter. The ends of the two wires are then soldered to the binding posts and well taped. The other ends of the cable connect with a small plug embedded in the side of the spool. The observer makes and breaks his connection through this plug. As the meter is lowered into the well the cable is temporarily secured to the plunger rod at intervals of 20 or 30 ft. in order to avoid the chance of snagging the cable.

Results of Tests

All tests made to date on wells whose head indicated a defective casing have been successful, the most startling record being on a 10-in. well, where a velocity of 5.6 ft. per sec. was recorded at a depth of 200 feet.

In some instances old defective wells have been covered up and it is not now an easy matter to find them, owing to the erection of buildings and improvements. To guard against this in the future maps and photographs have been prepared showing the location of all existing wells.

While the provisions of the existing law relative to waste are excellent and can be made effective on most wells, the law as it stands cannot be a guarantee against the still further depletion of the artesian basins. To make such a guarantee possible the city government must have complete control over all wells and be able to prevent additional borings.

Honolulu cannot escape the fact that 80% of her entire domestic supply comes from artesian wells, and that while her population is steadily increasing (at present approximately 70,000) her water-supply is diminishing.

Resurfacing Reduced by Patrol System on Boulevards

Crews Work Continuously in Kansas City, Making All Repairs with Stone and Hot Asphalt—Dust Laid by Power Sprayer

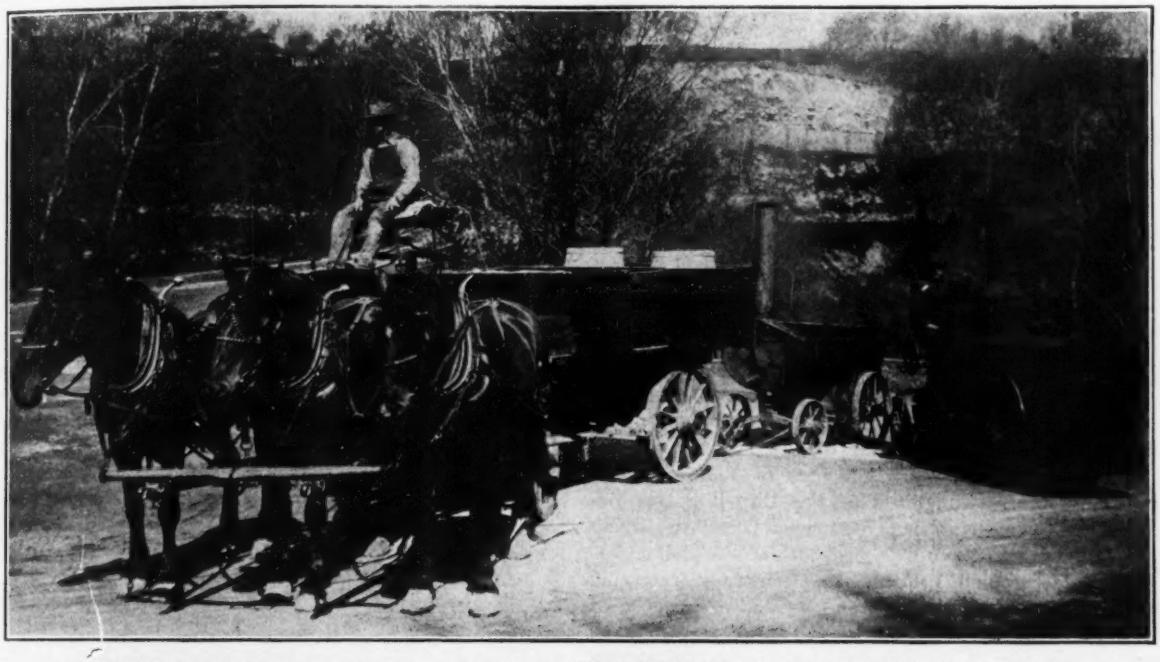
By Ralph R. Benedict
Assistant Superintendent, Board of Park Commissioners, Kansas City, Mo.

THE use of the patrol system for making repairs on boulevards has practically eliminated resurfacing charges in Kansas City, Mo. The crews work continuously and repair small holes as soon as they are formed, and thus prevent excessive raveling. Stone and hot asphalt

FOUR-MAN PATROL CREWS KEEP KANSAS CITY BOULEVARDS IN GOOD CONDITION

are the materials used, and this system of maintenance, coupled with an oil treatment to keep down the dust, has been very satisfactory. The oil is applied by means of a special power spraying device built by the park board.

The park and boulevard system was initiated in 1895 and the first paving was finished in 1897. The early pavements were so well built that they have never been resurfaced. They are mainly of a soft native limestone, built in two courses with a total thickness of 12 in. Water-bound macadam was used at first and bituminous macadam in later years. All thoroughfares under control of the park board are kept in good condition by repair crews, each consisting of four men with a three-horse supply wagon, a 3-ton tandem roller and a small portable melting kettle.



OUTFIT FOR BOULEVARD CREW CONSISTS OF SUPPLY WAGON, HEATING KETTLE AND ROLLER

The wagon box of the supply wagon is mounted on a low-wheel running gear and is divided into three compartments, which hold one ton of stone, 2¼ tons of grit and three barrels or drums of asphaltic cement. The melting kettle, with 150 gal. of hot asphaltic cement, is mounted on four wheels and trails behind the supply wagon. These crews and outfits make the rounds of the boulevards and park roads, repairing every break in the road surface, however small, and filling low places.

No preliminary work of picking or spiking is necessary. The repairing is done by simply brooming all loose material or moisture from the depressions or breaks and adding either 1-in. rock or small grit, depending on the size of the break. Hot asphaltic cement is poured over this in the proportion of about 1½ gal. per square yard, and then grit is spread over it and rolled. This method is used on water-bound and bituminous macadam and also on sheet asphalt.

Cuts in the roadways, made by the public service corporation and the plumbers, are patched by the repair crews, all excavations in the boulevards being controlled by permits issued through the board of park commissioners. When these excavations are ready for backfilling, the office must be notified at least four hours in advance, in order that an inspector may be present to see that the work is properly done. The filling is tamped back dry and in such small layers that settlement is prevented. This care of the backfilling is considered a very important detail in the proper maintenance of boulevard surfaces.

Road oil is applied early in June to all boulevards which have been repaired or which show signs of wear. This not only improves the appearance of the pavement but removes all trace of dust and waterproofs the surface. A residuum oil of 19° Baumé, from the mid-continent oil field, is used for this purpose. It has no cementing value and is used strictly as a dust layer.

The oil is applied by a power sprayer built by the park department and consisting of a 60-gal. steel tank mounted on the running gear of a former water sprinkler. The tank carries a small rotary pump, a compression regulating valve and a pressure gage. The pump is on the back of the tank, and is geared to a rear wheel by means of sprocket chains. It receives the oil as it flows from the tank and produces the necessary pressure at the three spray nozzles. Each nozzle consists of a very small slotted orifice in a plug screwed into an elbow attached to the discharge or distributor pipes. The pressure can be regulated by means of the valve operated by a man riding at the rear of the tank. It can be varied from zero to 30 lb., the former allowing the oil to flood the road, while the latter makes a fine mist and barely covers the surface. The operator can observe the condition of the pavement and apply as much or as little oil as is needed. As a safety precaution, half of a roadway is oiled at a time, and limestone screenings are cast over the fresh oil in such

quantities as to absorb any excess oil remaining on the surface.

Before the introduction of the patrol system of maintenance the condition of the surfaces of some of the boulevards was such that a certain number had to be resurfaced each year. Although traffic has doubled during the three years in which the system has been in force, not a yard of resurfacing has been necessary, and the cost of maintenance has been nominal. Last year 65 miles of boulevard was repaired at a cost of 1.2c. per square yard and oiled for 0.5c. per square yard, making a total cost of 1.7c. per square yard.

Under the provisions of the city charter Kansas City is divided into eight park districts, all under the board of park commissioners. Money for the maintenance of boulevards, park driveways, etc., under control of the board is raised by a levy on the land values of real estate in each district. George E. Kessler is landscape architect; W. H. Dunn is superintendent and the writer is assistant superintendent.

Flood Damage Is Checked by Storage Reservoirs

Irrigation Works Prevent Peak Discharge of Flood in Washington—Prompt Action Saves Canal and Lands

STORAGE reservoirs on the Yakima River, Washington, equalized the flow during the severe floods of last winter and thus reduced the damage. This is shown in the June number of the *Reclamation Record* by R. K. Tiffany, project manager of the Sunnyside and Tieton irrigation units of the United States Reclamation Service. Flood conditions occur in spring and fall, with maximum records of 30,000 and 60,000 sec.-feet respectively. Storage reservoirs for irrigation supply are planned, having an aggregate capacity of over 1,000,000 acre-feet, and those already completed have a capacity of 421,000 acre-feet, as shown by the accompanying table. Of these, Lake Clealum has a temporary crib dam while the others have permanent earth dams. The following is an abstract of Mr. Tiffany's paper:

The fall flood of 1917 came later than usual, beginning Dec. 14, after several days of heavy rain and warm weather following a fall of wet snow. A flood stage of 38,500 sec.-ft. was reached at the Sunnyside diversion dam on Dec. 19. Some protective work was done along the canal bank immediately below the dam, as the flood was beginning to cut the bank. Cooler weather checked the discharge for several days, but the river again began to rise on Dec. 27, and reports from the headwaters indicated that a flood considerably higher than the previous one must be expected.

Danger to the project works was threatened for only about ¼ mile below the Sunnyside intake, where it was feared that the flood might overtop the bank and follow down the canal, causing breaks which would damage the canal, farm lands, railroad lands and the little towns of Donald and Buena. It was decided that everything possible must be done to prevent this.

Calls were sent out from the Sunnyside office over all telephone lines at about 4 a.m., Dec. 30. The fire bell was rung in Sunnyside, and when the citizens turned out they were rushed to the headworks in automobiles. By 5 a.m. men and teams began to arrive, and by 9 o'clock about 200 men and 20 teams were on the job. With this force, during the next 12 hours, some 7000 sacks were filled with gravel and placed for protection of the river side of the canal bank and for raising the bank 12 to 18 in. for about ¼ mile. The teams were used to throw a dam across the canal below this protective work, so that if the water overtopped the bank it would be prevented from following down the canal.

Telephone reports were received from gages on the upper river. During the night of Dec. 30, some 30 or 40 men guarded this stretch of canal bank, filling new sacks to strengthen weak places or to replace those that were undermined and washed into the river. Waves were constantly splashing over the top of the sack dam and softening the canal bank, which was already weakened by the taking of material for filling the sacks. By noon the flood began to subside and the danger was past.

More than 100 automobiles brought farmers and business men, as well as all Government employees, from distances of 12 to 50 miles. It was necessary to establish a commissary service by means of trucks running from Sunnyside, 30 miles distant, the nearest source of supply. Before this was running smoothly, the local Red Cross auxiliary furnished an emergency luncheon to the first contingent of about 50 men.

Records show that water was stored during the peak of the flood at the different reservoirs in the amounts indicated in the table. The discharge compares with

INFLUENCE OF STORAGE RESERVOIRS ON FLOOD RUN-OFF IN THE YAKIMA RIVER

Reservoirs	Storage Capacity Acre-Feet	Max. Run-Off Stored During Flood Peaks — 1st Flood Dec. 15 to 20 Sec.-Feet	2nd Flood Dec. 28 to Jan. 1 Sec.-Feet
Kachess	25,000	7,400	5,520
Keechelus	210,000	7,020	5,580
Clealum	152,000	15,000	7,700
Bumping	341,000	6,900	.....
Total	421,000	36,320	18,800
Flood discharge at Union Gap	.....	38,500	50,000
Maximum flood (without storage)	.....	74,820	68,800

the previous maximum flood discharge at Union Gap of 63,300 sec.-ft. in November, 1906. In that flood only two wagon bridges remained in place across the Yakima River between Ellensburg and its mouth, a distance of 150 miles.

Without the regulation provided by the Government storage reservoirs, the floods of December, 1917, would have exceeded the great flood of 1906 by nearly 25 per cent. Storage reduced the 1917 flood stage by at least 4 ft. at Clealum and 2 ft. at Yakima and in the lower valley, where an additional 2 ft. would have flooded the country for a distance of ½ mile to 2 miles back from the river.

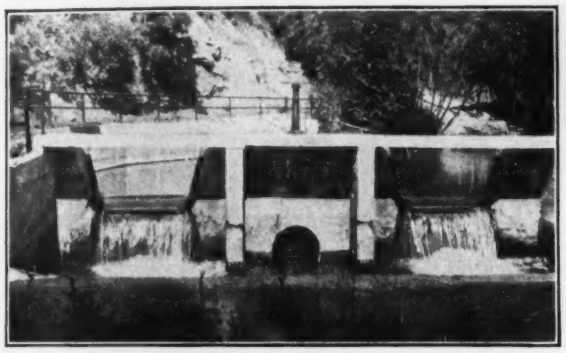
Upon the completion of the Tieton reservoir, with a capacity of 180,000 acre-feet and the Clealum reservoir, 501,000 acre-feet, the fall floods will be reduced by storage to a maximum of about 30,000 acre-feet, or about the equivalent of the maximum spring floods. This amount of water can be carried practically within the river banks with little damage to adjacent property.

Protect Water-Supply Creek from Pollution and Ice

Hydro-Chronographs in Concrete Houses Measure Portions Diverted to Different High Level Districts

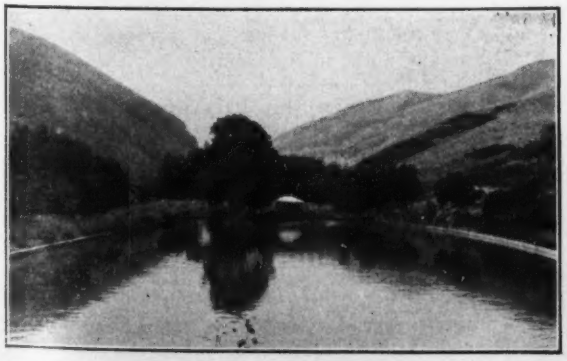
WATER supplied to high level districts of Salt Lake City is delivered by gravity through several cast-iron pipe lines leading out of pools in City Creek made by low Cippoletti weired dams. The stream is small and has a steep grade, and originally the flow was much hindered by rocks, débris and willows, which facilitated the formation of slush and anchor ice in winter. Removal of the obstructions has been carried on consistently for the past three years, about $2500 being expended each year on the 15-mile section covered.

To safeguard the purity of the water, derived mostly from springs, the flow of which is regulated by the Pleasant Valley 5,000,000-gal. reservoir, two men on foot and one mounted man patrol the creek for 15 miles upstream from the city. A city ordinance gives the department this authority. Picnic parties and incidental travel into the valley are induced by a well-kept drive maintained by the park department. No one is allowed, however, to camp over night in the cañon. Outhouses with pails, cared for by the patrols, are maintained at intervals of not more than one mile. Not the least of the duties of the patrolmen is a strict lookout for forest fires and recruiting of a force to fight them.



THESE DOUBLE WEIRS ASSIST IN KEEPING HEAD HIGH OVER INTAKE

At six of the seven Cippoletti weirs there are hydro-chronograph continuous recorders in concrete booths erected alongside the pools. For such small amounts the water is measured many times, for there is a constant influx from the side hills and it is desirable to know quite closely the amount to feed in from the Pleasant Valley reservoir so that none will be wasted below the lowest intake.



WHEN SLOPES ABOVE PLEASANT VALLEY GET DRY FIRE RISK IS IMMINENT

Entrances into the heads of the pipe lines are screened, usually by small rectangular frames with ½-in. screens set at an angle of 45 deg. with the inlet so as to bypass as much of the débris as possible. Below each inlet there is usually a second pool or a surge chamber maintaining a constant head on the pipe line and overflow back into the creek. Weirs above and below this inlet give by difference the amount of water let into the conduit. A weir and chronograph outfit consisting of two weirs and two hydro-recorders cost at the time $275 each. By the use of these weirs the gain or loss in the various sections of the stream between the several intakes can be accurately measured at all seasons.

WIDE WEIR AND HYDRO RECORDER IN CONCRETE HOUSE MEASURE FLOW IN RIPRAPPED CREEK

Ice fighting each winter costs about $2500. It consists of removing ice jams and débris obstructions brought down during high water. Both frazil ice and drifting fine snow make a mush which easily solidifies once the velocity is reduced in the service pipes. This condition usually obtains for five or six weeks. Cobbles cleared from the bed are used to riprap the sides of the stream.

The maintenance of the water department, formerly under the charge of Charles F. Barrett, superintendent, has recently been delegated as an economy measure to the city engineer, Sylvester Q. Cannon.

Receipts From National Forests Increase

National forests brought in $3,574,000 revenue during the year ended June 30, which was about $120,000 more than in the previous year. The cost of operation was $4,000,000, not including expenditures, for which Congress provided $700,000, to meet serious fires. Water-power permits brought in slightly less than $100,000, a falling off compared with the previous year attributed to uncertainties as to pending legislation. Timber sales totaled more than $1,500,000 and grazing permits more than $1,700,000. Turpentine privileges in the Florida forest produced a little more than $8000.

Factories Should Be Diffused Through Small Towns

Railroads, by Equalizing Rates, Must Play Large Part in Reconstruction and Readjustment Plan After the War

By C. C. McCHORD

Member of Interstate Commerce Commission, and of Railroad Wage Commission, Washington

THOUGHTFUL men are looking forward to a reorganization of industrial, social and economic conditions in this country and throughout the world when a treaty of peace has been signed that shall bring the war to an end. Vast armies and navies are then to be demobilized and the soldiers and sailors of which they are comprised returned as quickly as possible to peaceful pursuits. The reabsorption into productive industries of four million men or more drilled in the arts of war must in some way be accomplished. At the same time millions of employees in great munition plants and other industries, engaged chiefly in producing the necessities of war, will have to be diverted to the production of the things needed in times of peace. The problem is how this may be done in a way that shall be reasonably satisfactory to the workers of the country, and at the same time shall not lead to an interim of stagnation of production and business. The transition must not be left to chance. Comprehensive plans of reconstruction should be formulated at once.

Workmen who have had opportunity to enjoy life as the result of adequate pay are not going to consent, if they can avoid it, to any reduction in their wage scale unless there are compensating benefits. It is equally certain that the era of extremely high prices for the necessities of life will not continue during times of peace. The great class of nonproducers represented by clerks in offices and stores, salaried men in every calling, employees of public utilities and the like, cannot long continue to pay ever-increasing living costs unless they too receive further material increases in rates of pay.

Wider Diffusion of Factories

What is needed in this country is a wider diffusion of manufacturing industries and the local supply of the necessaries of life. There are many considerations that dictate a relocation of our manufacturing industries. It costs more to do business in a city than in the country. Land values and costs of construction of plants, taxes, etc., constitute charges that must be met from earnings. It also costs more to live in a city than in the country. A lower wage payment in the country than in the city would enable the workman to secure more comforts of life, to clothe his family better, and educate them more adequately. If the factory is located near the raw product there is saving in transportation costs which will be reflected in net earnings.

If wage scales are to be readjusted downward to meet conditions in times of peace, the wider diffusion of factories presents an alluring way out. What the workman desires, and what he has the right to demand, is opportunity to live in comfort. Reduction in the rate of his daily wage means, as he now sees it, lessened opportunity to secure to himself and his family those necessities which go to make comfort in daily life. In almost any country town of 1500 or more population in the Middle West or the South there is opportunity to live better and enjoy more of the real comforts of life, at materially lower wages than would secure even an approach to the same state of livelihood in any congested manufacturing center. In the country there are pure air and sunlight. The surroundings are clean, sanitary and moral. In such an atmosphere a workman can easily rear a family of sturdy boys and girls, and live a life of peace and happiness impossible for him to live in the crowded and unwholesome conditions of congested centers. In the country he is afforded opportunity to buy products of the soil first hand for his table at reasonable prices, and the admirable schools and religious institutions now in existence everywhere insure to his children every chance to lay the foundation of good citizenship.

To Make the Small-Town Factory Pay

There is hardly a town of 1000 population or more in the Middle West that from 1875 to 1895 did not endeavor to obtain, and succeed in obtaining, manufacturing industries. Many of these factories proved to be failures. Not all were properly located, but most of them should have survived, and would have done so but for influences that made success impossible. Among the chief of these was the fact that the railroads favored certain manufacturing centers in the way of facilities and rates. Preferment to long hauls in large lots, the granting of rebates to large shippers, the levying of excessive rates against certain localities to make up for the meagerness of returns where keener competition forced the rates down, the killing off by the railroads of inland water traffic—all these conditions rendered it impossible for the factory in the small town to compete with that in the larger and more favored city. Hence it came about that the large part of our manufacturing is done in the cities.

The railroads, therefore, must play an important part in the readjustment that must be made in our industrial and economic conditions. Thoughtful study should be given to the equalization of rates for freight transportation. Transportation by boat on our rivers and coast lines should be encouraged to relieve rail carriers at congested cities and ports. Rates should be made and facilities provided so that each port of the United States shall receive its share of traffic under the most economical transportation conditions. The opportunity to do a manufacturing business at a profit should be afforded at any point in the country.

Maintains High-Speed Ship Riveting for Five Days

Two riveting gangs at the shipyard of the Groton Iron Works, Groton, Conn., recently made five-day averages of 1202 and 1138 rivets per day, according to the *Emergency Fleet News* of July 25. The work was of difficult character, being on oil-tight outer bottom work, ⅞-in. pan-head countersunk-point rivets. Each gang consisted of riveter, holder-on, passer and heater. Working nine hours per day, one gang made daily records varying from 1185 to 1241 rivets, while the other drove from 1058 to 1181 rivets per day. Not one of the rivets was cut out.

Ton-Mile Charge to Maintain Highways Suggested

As They Are Public Utilities, Funds for Their Up-Keep Might Be Raised as They Are for Other Public Utilities

By J. Strother Miller, Jr.
Barber Asphalt Paving Co., Maurer, N. J.

TON-MILE rates are used extensively as a basis of revenue by public service corporations, and there is no reason why the public highways cannot be maintained by the same system. The public highway is as much a public utility as the railroad. The railroad is built by private capital for private gain, and those who utilize its service pay in proportion to the amount they use. The highway is built by the state for public use, and by the same logic each individual should pay in proportion to his use of it.

Before the advent of motor vehicles, county highway traffic consisted mostly of local teams moving within a very restricted area; those passing through on long journeys were few and far between. Later came the motor vehicle, at first a novelty, used only as a pleasure car, but with a more extended radius of travel. Then the motor truck appeared, at first confined to a rather restricted district. Now, under the stress of war, we see regular highway freight services established between large cities a great distance apart, such as that between Akron, Ohio, and Boston.

Naturally, while the highway was a matter solely concerning the local community, local taxpayers felt an obligation and interest therein, and willingly paid their road tax. When it became an intercounty necessity, the state assisted financially. And now the evolution has continued until, on certain highways, whether interstate or not, we see Federal aid extended.

In the early stages private corporations operating toll roads endeavored to improve the situation, and those using the better highways most had to pay proportionately. As the radius of travel became longer, the toll roads were largely eliminated by public demand for free routes. All states now require a fee from every owner of a motor vehicle. Some states have a graduated fee based upon horsepower or capacity. These fees are generally used to cover the cost of maintaining the licensing department, the major portion of the balance being assigned to the highway department for maintenance and repair. Such a method of graduated fees, with possibly a limitation as to the size of trucks, is a step in the right direction, but does not take into account a most important variable in the problem.

One owner uses a passenger car for combined business and pleasure. His car is of average weight, pneumatic tired, and his average trip is to and from business, with an occasional pleasure trip of greater length. Another owner uses a delivery truck with hard tires for local deliveries, running loaded only in one direction. Still another truck passes over the same road twice a day, heavily loaded in both directions. Which car should pay the most toward the maintenance of that road?

As stated above, a railroad is a public utility owned and operated by a private corporation under state and Federal regulation. If an individual wishes to use the right-of-way of a railroad, he does not pay an annual fee dependent upon the supposed loaded capacity of his private car, but, rather, he pays a mileage rate, which rate no doubt includes the cost of power, a proportionate share of the cost of maintenance, amortization, labor, and in addition thereto a profit to the corporation. Nor do the residents or property owners along that right-of-way pay a railroad tax.

A highway is also a public utility. Why should not users thereof pay a mileage rate? Here the state is the owner; residents or property owners along the right-of-way receive certain benefits even though they do not own vehicles, and these benefits are justly assessed as a road tax; but the vehicle owner, using that road constantly, should pay a proportionately larger share than one using it intermittently. This mileage charge, a ton-mile rate if desired, should be the chief means of paying maintenance costs. Weight of vehicles per inch width of tire should be a factor in the rate, and single loads in excess of a certain quantity could either be prohibited or charged a mileage rate so excessive as to eliminate them.

The law enacted by the legislature of Maryland which took effect July 1, 1916, is in the direction suggested, but covers a definite daily service between fixed points over fixed routes. If this could be extended to cover all users of the highway on a graduated mileage charge, it would, in my opinion, tend to solve the difficult problem with which we are now struggling.

Some may object to this proposal as a reversion to conditions existing when we had toll roads. This is not the case. If state motor vehicle fees are not maintaining roads as they should be maintained, then these fees should be increased. This has been done in many states. A system of general state fees, while differentiating between various motor vehicles, makes no distinction between the constant and intermittent user. This is certainly more unjust than a graduated ton-mile rate, and if we are satisfied with graduated state fees, we should not object to a modification thereof whereby the cost of maintenance is more equitably distributed among the users of the highways.

Davenport's Garbage Is Utilized

UNDER a 10-year contract, awarded June 7, for the collection, removal and disposal of garbage and dead animals, the City of Davenport, Iowa, is to pay $12,500 annually until January, 1920, after which the payment is to be 20c. per capita on the basis of the 1920 census. An annual license fee of $50 per wagon is to be paid by the contracting company, which also is required to give a bond of $10,000, to be renewed annually. Provision is made for cancellation of the contract by the city after two years if the service should be unsatisfactory. The contract was awarded to the Tri-City Disposal Co., organized by J. H. Kelly, of Davenport.

Garbage is being fed to hogs, but the contract does not specify the method of disposal. It does provide, however, that after three years the city has the right to require the construction of a reduction plant. It also authorizes the city to purchase this plant at 75% of the appraised valuation after it has been in opera-

tion for five years. The contractor has purchased the city's wagons, horses and other equipment used in this service. The contract time is to date from June 1.

Collections are to be made daily from hospitals, restaurants, hotels, fish stores, etc. Elsewhere they will be made twice a week during the May-October period and once a week during the November-April period. Two watertight cans must be used by householders, one for garbage and the other for general refuse. The work is to be done under the direction of the Board of Health. Thomas P. Kennedy is health officer.

Collection of garbage has been made hitherto by the city, and the material deposited as filling for made ground behind the new river-front wall. Layers of garbage were covered with clean sand, as described in *Engineering News-Record* of June 7, 1917, p. 482. During the negotiations for the present contract it was proposed that the company should furnish sand sufficient to make up for the loss of garbage as fill. Instead of this, the company reduced its bid $600, as the estimated cost of 1600 cu.yd. of sand, equivalent to 8000 cu.yd. of garbage. The annual quantity of the city's garbage is about 8500 tons.

Opposition to the contract was made on the ground that the matter had not received sufficient investigation and that other cities received pay for their garbage instead of paying for its removal. The contract seems to have been handled entirely between the city council and the company, without consulting an engineer. The contract was first awarded in April, but at the election a short time afterward an entirely new city council was elected. The matter was taken up by the new council and the contract was awarded again after certain changes had been made.

The company has similar contracts with the neighboring City of Moline, Ill., and the United States Arsenal at Rock Island, Ill., while it is negotiating also with the city of Rock Island, Ill. These cities are close together. The Moline contract dates from July 1. About 2000 hogs are now being fed, but the number will be increased to 3000, as corn and tankage are fed in addition to garbage. Hog ranches are just outside the city limits, or about three miles from the centers of the cities.

New Zealand Engineer on Hydraulics

Short papers on hydraulics have been reprinted for private circulation by E. Parry, Public Works Department, Wellington, New Zealand. The first one, which is only some two pages in length, is on "Surface Friction of Fluids" (from the *New Zealand Journal of Science and Technology*, May, 1918). It calls attention to a "theory of fluid friction applicable to turbulent flow and sufficient for the purpose of a working hypothesis" published as long ago as 1883 by Reynolds in the "Philosophical Transactions of the Royal Society," Vol. 176, p. 935. The second paper, on "The Resistance to the Flow of Water Through Pipes" (from "Transactions" of the New Zealand Institute, Vol. 50, pp. 45-55, 1917) is a continuation of a discussion of the same general subject by Mr. Parry published in the same periodical (Vol. 48, pp. 481-89, 1916). Mr. Parry calls attention to an important correlation, basedon Reynolds' experiments, between fluid friction.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Use of Average and Medium in Rainfall Statistics

Sir—Harry M. Roeser, in a letter to *Engineering News-Record* of May 9, p. 925, objects to the use of the median in rainfall statistics. It should be first noted that the writer, in his letter published Mar. 28, p. 628, did not advocate the median "rather than" but "as well as the arithemetic mean. It should also be noted from the trend of the original letter that "prediction" was confined to the determination of a most probable average annual rainfall, or precipitation, as perhaps it should more properly be called.

In spite of Mr. Roeser's objection, the fact remains that eminent statisticians differ in their opinion as to the best method of averaging various statistics, rainfall along with the rest.

The desirable properties for an average to possess are as follows ("An Introduction to the Theory of Statistics," by G. Udny Yule, 1912):

"(1) An average should be rigidly defined, and not left to the estimation of the observer; (2) it should be based upon all the observations made; (3) it should possess some simple and obvious properties to render its general nature readily comprehensible, and should not be of too abstract a mathematical character; (4) it should be possible to calculate it with reasonable ease and rapidity; (5) an average should be as little affected as may be possible by what is termed 'fluctuations of sampling'; (6) the measure chosen shall lend itself readily to algebraic treatment.

"There are three forms of average in common use: (1) the *arithmetic mean;* (2) the *median,* and (3) the *mode,* the first named being by far the most widely used in general statistical work. To these may be added (4) the *geometric mean* and (5) the *harmonic mean,* more rarely used, but of service in special cases."

The *arithmetic mean* of a series of values is the quotient of the sum of the values by their number. The word *average* or *mean* is very generally used to denote this particular form of average.

The *median* may be defined as the middlemost or central value of the variable when the values are ranged in order of magnitude; or as the value such that greater and smaller values occur with equal frequency; or as that value than which there are as many occurrences greater as there are less than it.

The *mode* is the value of the variable corresponding to the maximum of the ideal frequency-curve which gives the closest possible fit to the actual distribution. Another way of defining the mode is as the position of greatest density or that variable which occurs the greatest number of times.

The *geometric mean* of a series of values is defined as the product of the value to the 1/*n*th power, or the log of the geometric means of the series of values is the

arithmetic mean of their logarithms, $log\ G = 1/N\Sigma(logX)$ It is always less than their arithmetic mean.

The *harmonic mean* of a series of quantities is the reciprocal of the arithmetic mean of their reciprocals, or $1/H = 1/N\Sigma(1/X)$.

For broad-scale predictions, the use of probability paper has been advocated (originally by Allen Hazen, see *Transactions* of Amer. Soc. C. E., Vol. 77, p. 1539 (1915); *Eng. News*, of Jan. 6, 1916, p. 4; and *Journal of Electricity*, Vol. 38, p. 338).

Gauss' law of distribution, referred to by Mr. Roeser, is an old law, used as the basis for the theory of least squares, and is the basic law in the study of probability of error as well as of distribution. The question of probability of error in the records is a very different one from that of the probable cyclic variation of rainfall. If rainfall occurred in uniform cycles, the third or the fifth method of averaging as mentioned above, and not the first, would be the logical one to apply. Nevertheless, the two types of variation must be considered together in rainfall statistics.

Unfortunately, the distribution of rainfall, while undoubtedly following fixed laws of nature, is affected by so many secondary contributory causes and laws that it follows no uniform curve of variation. The causes for the variation in rainfall are so complex and numerous that to date the human mind has been unable to grasp them in their entirety and reduce them to mathematical formulas.

Prof. L. H. Moore, in "Economic Cycles, Their Law and Cause," has referred to Brückner's cycle, which has been studied in a report available to the writer but not as yet published (soon to be presented in Stone & Webster's *Public Service Journal*).

In studying rainfall statistics we must consider the *use* to which the results are to be put. Do we wish to arrive at a rigid mathematical average or a most probable average? In some kinds of hydraulic investigations, the former is preferable and in others the latter. In this connection, note the desirable properties of an average, quoted above.

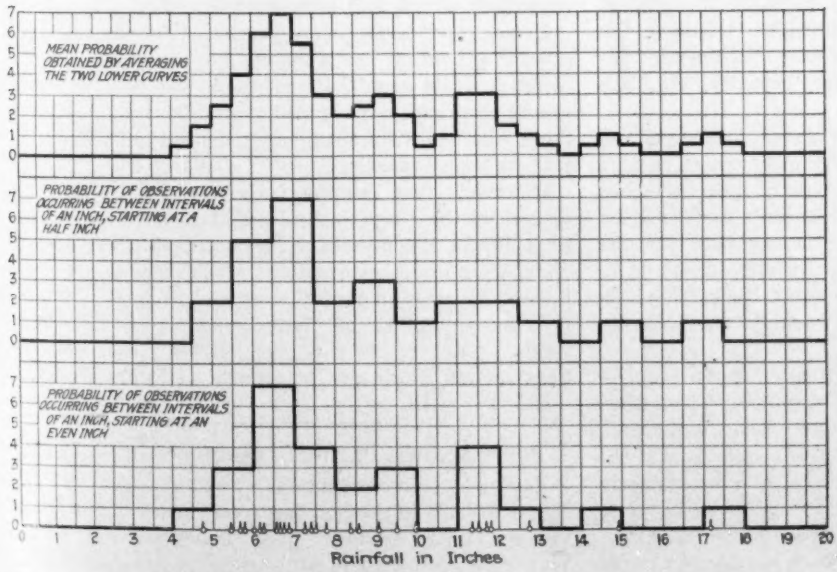
In view of the many uncertainties involved in the study of rainfall and the making of broad predictions therefrom, the question is, what method of averaging can be used to the best advantage. The writer's conclusion, not necessarily a settled one, is that both the *arithmetic mean* and the *median* are useful, the latter especially so when studied by the use of probability paper.

This question was raised with a definite object in view. The subject has been presented, among other questions, for discussion by the Boston Society of Civil Engineers' committee on New England run-off. As a member of this committee, the writer thought that if a few good discussions of the question could be brought out through the columns of your periodical, which reaches such an extensive number of engineers, a direct benefit would accrue to this committee. He is, therefore, grateful for Mr. Roeser's valued discussion, and hopes others may add to it.

Boston. DANA M. WOOD.

Sir—Referring to the discussion of the most probable value of rainfall by Dana M. Wood, *Engineering News-Record*, Mar. 28, p. 628, and by Harry M. Roeser, the issue of May 9, p. 925, the accompanying example is given in which neither the arithmetic mean nor the median appears to be the most probable value. The tables and diagram show the observed rainfall data at Reno, Nev., for 27 seasons, from July, 1888, to June, 1915.

The number of observations falling between intervals of an inch are tabulated and plotted (1) starting with an even inch; (2) starting with the half-inch. The upper of the two curves in the diagram is obtained by taking the mean of the two lower curves.


MEAN PROBABILITY OBTAINED BY AVERAGING THE TWO LOWER CURVES
PROBABILITY OF OBSERVATIONS OCCURRING BETWEEN INTERVALS OF AN INCH, STARTING AT A HALF INCH
PROBABILITY OF OBSERVATIONS OCCURRING BETWEEN INTERVALS OF AN INCH, STARTING AT AN EVEN INCH
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Rainfall in Inches

RAINFALL AT RENO, NEV., FOR SEASONAL YEARS JULY TO JUNE FOR PERIOD JULY, 1888, TO JUNE, 1915

Arithmetic mean, 8.62 in. Median value, 7.5 in. Most probable, 6.75 in.

The arithmetic mean of the 27 seasons is 8.62 in., in., and the most probable value, as judged by the value at which the observations occur most frequently, is 6.75 inches.

The example given is typical of stations throughout the semiarid and arid portions of the country, while the method of procedure taken in finding the most probable value is in accordance with the principles of probability, as set forth in the standard books on the subject.

The writer has given some attention to the principles of probability as applied to rainfall and run-off measure-

OBSERVED PRECIPITATION AT RENO, NEV., FOR SEASONAL YEARS, JULY TO JUNE, FROM JULY, 1888, TO JUNE, 1915

1888-89	7.23	1900-1901	11.35	1912-13	6.22
1889-90	17.16	1901-02	6.71	1913-14	14.93
1890-91	11.49	1902-03	7.49	1914-15	5.44
1891-92	6.00	1903-04	8.54		
1892-93	11.77	1904-05	7.40	Total	27) 232.82
1893-94	5.64	1905-06	7.76		
1894-95	6.85	1906-07	11.70	Mean-27 yr.	8.62
1895-96	8.35	1907-08	6.63		
1896-97	9.95	1908-09	9.50	Median*	7.50
1897-98	6.55	1909-10	6.16		
1898-99	5.76	1910-11	12.73	* (Obtained from diagram.)	
1899-1900	9.05	1911-12	4.76		

Number of Observations Occurring Between Intervals of an Inch. (1) Starting with an even Inch. (2) Starting with a Half-Inch.

Interval	No. of Observations	Interval	No. of Observations	Interval	No. of Observations
3-4	0	14-15	1	9.5-10.5	1
4-5	1	15-16	0	10.5-11.5	2
5-6	3	16-17	0	11.5-12.5	2
6-7	7	17-18	1	12.5-13.5	1
7-8	4	18-19	0	13.5-14.5	0
8-9	2	3.5-4.5	0	14.5-15.5	1
9-10	3	4.5-5.5	2	15.5-16.5	0
10-11	0	5.5-6.5	5	16.5-17.5	1
11-12	4	6.5-7.5	7	17.5-18.5	0
12-13	1	7.5-8.5	2	18.5-19.5	0
13-14	0	8.5-9.5	3		

ments, and feels that the subject should receive more attention from engineers than is apparent from discussions on the subject.

L. STANDISH HALL.

San Francisco.

Proposed Solution of Highway Transportation Problem

Sir—Your editorial of recent date relative to the New York *Evening Mail's* solution of the highway transportation problem again draws attention to the all-important need of proper regulation of the load and speed of motor trucks and the corresponding standardization of highway construction.

Truck manufacturers, transportation companies, and highway engineers and officials must meet on common ground and formulate plans which will bring these interests into closer harmony. Unity of effort and definiteness of direction seem, just now, to be missing factors. The designers of trucks are striving to give the users a product which will render the most economical service (this not necessarily meaning the biggest possible load), therefore they naturally look upon the opinion of the owners of trucks as a "barometer" indicating wherein changes in size, capacity, etc., are needed.

These trucks must travel over paved roadways, and if the roads will not sustain the various stresses created by the moving vehicles, then the companies operating the trucks, the manufacturers who built and sold the trucks and the taxpayers whose money paid for the roads are all losers. The engineers who built the pavements will also be subjected to severe criticism for having failed to provide structures equal to the task for which they were intended.

However, pavements which will meet traffic requirements cannot be designed until engineers know what loads must be carried, at what speeds trucks will travel, and what the tire widths for any given capacity will be; this list neglects mention of many other constantly changing factors of design and operation. It therefore becomes certain that no one of these interests can accomplish much alone. The "equation" must be cleared of its "fractions" by reducing to a "common denominator," and this must be done before any scheme for handling highway transportation will produce results in any way proportionate to the labor and capital invested.

Almost none of the really vital problems of highway construction have been solved. However, engineers are giving these matters most serious thought, as may be noted from the increasing amount of attention and publicity given to drainage, frost action, foundations, wearing surfaces, maintenance, length of service, costs, etc. A vast amount of actual data (facts rather than somebody's ideas) is sorely needed. Much of this information requires time for its collection, but we are gradually accumulating it, and given some sort of known load and speed factors (something which will not change before paving plans for a given job can be completed), an early and effective solution of the paving problem will result.

On first thought, it would seem that a great many difficulties, unlike those presented by the use of streets and highways for rail transportation, conduits and other public utility purposes, would offer obstructions to a scheme subsidizing highways for motor transportation. Any company launching such a project would want more or less to say about the kind of pavement, the location of the road, etc. If a right-of-way for this purpose were actually purchased from the people, the new owners would naturally want to exclude other traffic, for economic reasons. If permission to use certain streets and roads were obtained, the very fact that such are public property would establish the right for general traffic, which might or might not inconvenience the forwarding company. Also, such an arrangement would make very difficult the matter of tax apportionment, to cover first cost and maintenance.

It is doubtful that any plan contemplating procurement of absolute right-of-way could at this time be shown to warrant the enormous initial expenditure necessary therefor. It is also doubtful that any legal way could be found whereby such a company could secure limited right to use the certain streets and highways which would form a connected whole, thus affording a reasonably direct and uninterrupted route.

Unless right-of-way were purchased for the sole purpose of providing paved routes for these private concerns, it would seem that the people who own the roads should continue to pave and maintain them, and that those who use them should foot the bills through some fair scheme of taxation.

However, since nothing is impossible, the idea advanced by the *Evening Mail* might solve its own problems during the process of development. But, as you state, there are other questions which must be answered before any great amount of time need be spent in weighing the possibility of centralizing control of motor traffic.

H. W. SKIDMORE,
Construction Engineer, Department of Public Works.

Oak Park, Ill.

Force Account Paving Saves Money at St. Paul

Paving by force account has saved the city of St. Paul, Minn., $73,000 in the past four years, according to Oscar Claussen, city engineer. The Department of Public Works has completed 32 paving jobs, in competition with the contractor's lowest bid price, and in every case a saving has been accomplished. The total saving given above is exclusive of depreciation charges.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Proper Quality of Construction Supplies Important

POOR supplies can cause a lot of trouble on construction work. Coal was hard to get last winter and was often found to be of the unburnable variety when received. These facts were being discussed resentfully by the job blocksmith in whose shop the editor was warming himself after a frost-biting hour on the work. Poor coal had upset the blacksmith's temper. This was bad. Still worse, the coal was upsetting the temper of his steel. Less footage of hole per sharpening was being drilled.

Out on the job the boilers were giving trouble. One veteran steamer whose insides had been riddled by years of hard living was refusing to digest its poor provender.

Good coal was beyond the reach of the contractor in the circumstances mentioned; but contractors too often let the same trouble arise when the coal supply is normal. Generally, this is carelessness or oversight. Just the same, such inattention disarranges things and costs hard money. Buying first-class supplies, under specification if necessary, is just as important as buying good construction materials and the right construction plant. C. S. H.

Wooden Shoes Used on Concrete Mixing Boards

BY ALBERT A. NORTHRUP
Hog Island, Pa.

THE well-known tendency of cement to destroy shoes was overcome on the work in South America, described on page 401 by the use of shoes with heavy wooden soles.

Concrete was being mixed by hand and the laborers could not be kept on the job because the cloth slippers with rope soles usually worn by them soon became saturated with cement-impregnated water. The difficulty was overcome by furnishing them with wooden-soled shoes with leather tops.

Other Articles in This Issue of Interest to Contractors:

Weighing Concrete Materials Saved Cement on Three Big Dams Page 393
Bridge at Lyons Named in Honor of President Wilson Page 399
Americans Build Sewer and Water Systems for Three Uruguayan Cities Page 401
Heavy Construction Hauling Practice Modified by War Conditions Page 405

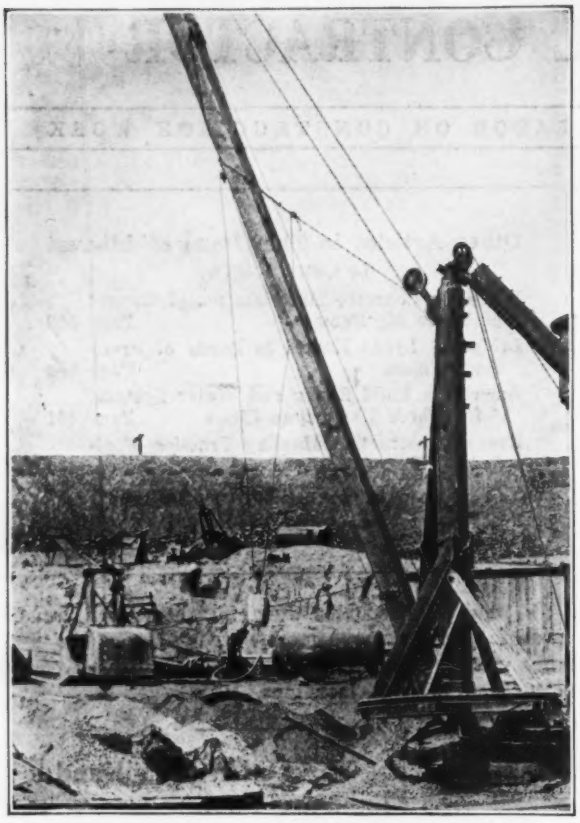
Have You Read "Berlin or Bust?" (Page 421)

Tagline Rig Gives Direct Pull and Eliminates Fouling

FOULING of the tagline with the mast and boom, and with the falls when the bucket is in low position, is prevented by the new arrangement shown in the illustration. This rigging is said to be very convenient when excavation is made from narrow spaces, as between trench sheeting, and for digging below the level of the derrick.

In the particular layout shown in the photograph, a cylinder of concrete was used for the tagline weight. The tagline is attached to the clam bucket at one end, while the other is fastened to the becket end of the boom fall. It is rove through three blocks, one at the

WOOD-SOLED SHOES FOR LABORERS PROVED GOOD INVESTMENT ON SOUTH AMERICAN JOB



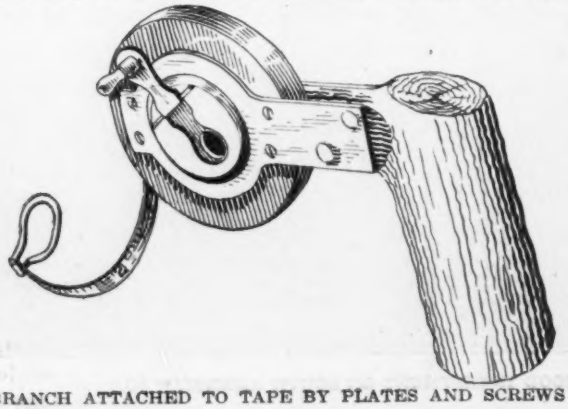
TAGLINE RIGGED TO BOOM TO LOAD WAGONS AND EXCAVATE MATERIAL FROM NARROW PITS

foot of the boom, one near the middle of the boom and one at the weight. This gives a more direct pull upon the bucket, which allows for excavation in a lower position without twisting of the bucket falls with the tagline. It also prevents the fouling of the tagline with the mast and boom as the boom is swung into position. With properly placed wagons, it is unnecessary to turn the bucket to dumping position by hand.

Branch Makes Pistol-Grip Handle for Tape

BY A. J. CAHEN
Brooklyn, N. Y.

A PISTOL-GRIP handle, made by cutting a piece from the limb of a tree just below a branch, and fastening to the ordinary engineer's pocket type by means of fitted plates passing from the tape to the small projection of the branch, which is left on, is shown in the illustration. The addition of this handle makes it much more convenient to hold the tape when unwinding or winding up, especially when the hands are cold.

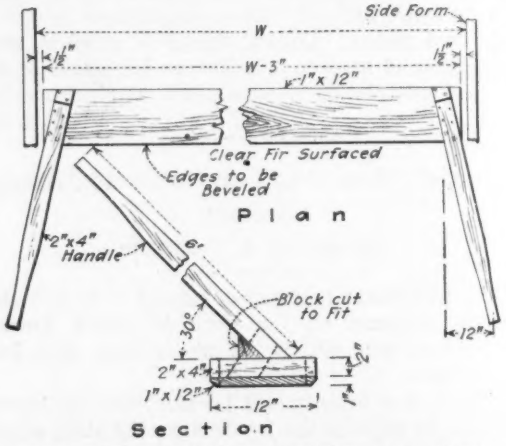


BRANCH ATTACHED TO TAPE BY PLATES AND SCREWS

A branch about ¾ in. in diameter is the best size to use. The strips of sheet metal can be fitted to the metal fittings of the tape in any machine shop, and may be of any thickness which will not interfere with the winding handle. The strips are attached to the case by small screws which pass through the rim of the case in locations which will not interfere with the type on the inside. Rivets or screws, as desired, may be used to fasten the strips to the handle.

Device for Finishing Concrete Pavements Said To Save Labor

THE home-made finisher shown in the illustration is reported to finish the surfaces of concrete pavements with less labor and quicker than the canvas belt, according to J. C. Hills, county engineer, Bellingham, Wash., who states in a recent issue of the *Concrete Highway Magazine* that he has surfaced a considerable area of pavement with this tool, with perfectly satisfactory results. It was designed to work in conjunction with the concrete roller.

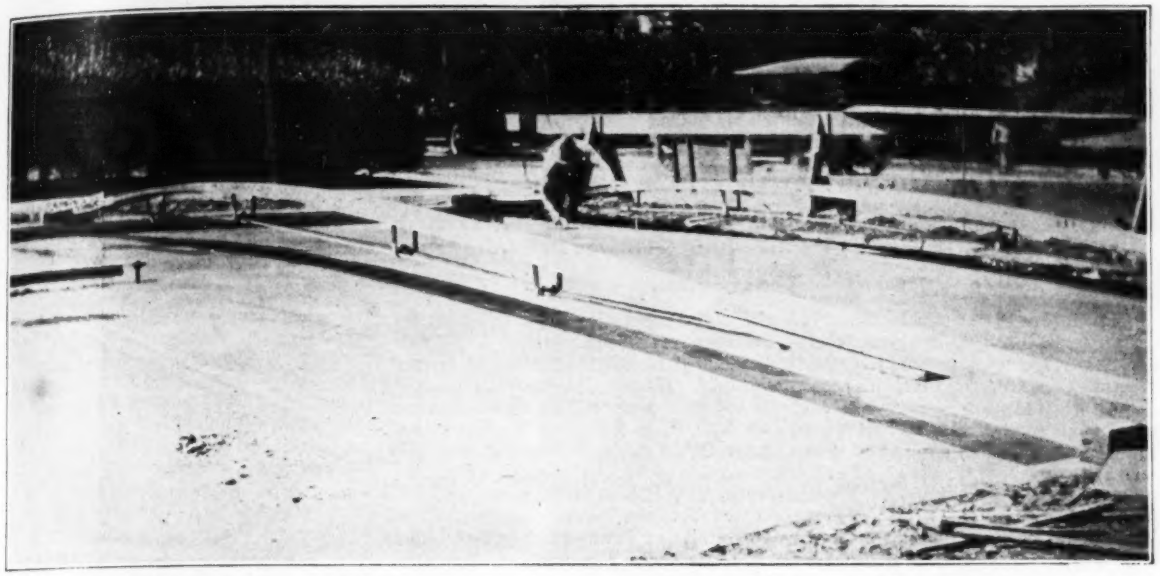


INEXPENSIVE CONCRETE FINISHER REPLACES CANVAS BELT METHOD

When the concrete has been spread and rolled the finisher is passed over the slab two or more times, and a perfectly even surface with the degree of grittiness required to prevent skidding is produced. For the best results the concrete should be mixed fairly dry, containing just enough moisture to produce a workable mix. The roller forces the coarser aggregate down, and the plank smooths out the ridges and irregularities.

Lengthens Scant Finishing Bridge

LENGTHENING of a concrete pavement finishing bridge which was too short was accomplished on a recent contract as shown in the illustration. Where a contractor is working on several different streets, it



CONCRETE PAVEMENT FINISHING BRIDGE LENGTHENED BY BOLTING PLANK AT THE ENDS

often happens that the finishing bridge made for one street will not serve upon the others, on account of their different widths. In the case illustrated the contractor overcame the difficulty by bolting a heavy plank to each end and making up for the extra deflection by blocking up at curbs. A man working upon a similarly lengthened bridge is seen in the background.

Use Pipe Ram to Tamp Trenches in South America

BY ALBERT A. NORTHRUP
Hog Island, Pa.

THOUGH far from home the forces of the Ulen Contracting Company in Uruguay still knew how to make an effective ram for tamping the backfill in trenches, as is shown by the photograph. The ram was made by cutting off about 40 in. of the bell end of an 8-in. cast-iron pipe, drilling two holes at right angles through both sides of the pipe at the upper end, through which were run two short lengths of wrought pipe for handles, and filling the cast pipe with concrete.

RAM MADE OF PIPE LENGTH FILLED WITH CONCRETE

The four men manipulating the tamper are typical specimens of the labor in Uruguay, except the one on the right who is marked by his boots as a "caballero," or gentleman, in reduced circumstances. The class which owns and wears top boots in Uruguay is not popularly supposed to work with the hands if it can be avoided.

The work, which is described on page 401, was carried out under the direction of H. C. Ulen, president of the contracting firm, and Thomas Shepperd, vice president and general manager. Stone & Webster and the American International Corporation, associated with the Ulen Contracting Company in the work, were represented by the writer.

Women Replacing Men in British Industry

According to recent reports, the number of women directly replacing men in Great Britain in April, 1917, was estimated at 1,256,000, of whom more than three-fourths were found in industrial and commercial occupations and in government employ. In January, 1918, according to the *British Labor Gazette* of June, 1918, this number had increased to 1,442,000. The degree to which women replace men varies widely in different industries. In government establishments, not including controlled establishments engaged in munitions work, they formed 36% of the total employees; in banking and finance, 24.6%; in commercial occupations, 16.9%; in engineering firms, 7.14%; and in all metal trades 6%. These figures refer only to the women directly replacing men. Many others are engaged in work in which they replace only partially, or indirectly, men who have been withdrawn for war service or for work in other industries.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

The University of Uncle Sam

All Colleges to Be Converted Into Military Training Posts—Expected to Turn Out 310,000 Officers and Technicians by Next July

(Washington Correspondence)

"The University of Uncle Sam," so Frederick P. Keppel, assistant secretary of war, has aptly termed the greatest educational effort that this country—or probably any other—has ever made. The student output, half a million; the educational plant, 500 institutions; the purpose, to give Uncle Sam the most intelligent army that history has known.

Best of all, the announcement can be made with full confidence of success, for already there are 47,000 men in the schools and they are being turned out at the rate of 23,000 a month.

The training plan referred to has already been described in *Engineering News-Record*. It consists of two parts—the training of technicians, and of young men in college. Plans for the latter division, known as the Students' Army Training Corps, were in hand before it was decided to lower the draft age to 18. Military training was to go hand in hand with the usual courses.

In two weeks' time, all plans have gone by the board. The certain lowering of the draft age has done it. Standard college courses are wiped out, and no college will operate this year except as a military training school. The plans announced for Brown and Lehigh and Rutgers, discussed in this journal last week, are laid by for the period of the war at least.

Dr. C. R. Mann, who studied engineering education for the national societies and the Carnegie Foundation, and who is now on the advisory board working with the army committee on these matters, put the new plan before the Senate Committee on Military Affairs last week. Men prepared for college will register as usual, and will as soon as all arrangements are completed, be inducted into the army as privates, with a private's pay and subsistence. In other words, they will be under full military jurisdiction. Boys of 20 will stay in school three months; those of 19, six months; those of 18, one year. In all cases men who clearly show that they may make good army officers or technical experts may be detailed to take further instruction. It is expected that at least 125,000 men will be enrolled under this part of the plan, and to date 320 schools of collegiate rank have been accepted as training posts.

The other division is that already in successful operation—the training detachments for mechanicians. These now become part of the Students' Army Training Corps. In addition to the 90,000 men who will have been turned out by Oct. 1, the quota for the period from Oct. 1 to July 1 is 220,000. Already 147 schools are engaged in this work, and 120 of them have been accepted for the winter courses. The University of Texas will be able to take care of no less than 5000 of these men at one time.

Democracy and merit will dominate Uncle Sam's khaki university. All the students being soldiers on pay and subsistence, the length of dad's pocketbook is not a factor in the matter of entrance. The necessary qualifications are willingness and ability. Men who after entering a training detachment show ability to carry college work will be transferred thereto, and in general, the only qualification for any part of the work is ability to carry it.

While the men are taking their school work the usual drill instruction is carried out. Experience with the technician detachments shows that in military proficiency the boys are not behind those who spend an equal time in the cantonments.

The plan has been worked out admirably and in conformity with military needs. It neglects the civilian demand for engineers and should that shortage become more acute, it may be necessary for the Government to take steps for the maintenance of the necessary municipal sanitary enterprises.

But for war needs, the scheme has been excellently prepared. Aside from its military results, there will be a tremendous psychological benefit from placing these centers of patriotism and military endeavor in hundreds of cities, where soldiers before were merely men on leave. The moral effect is likely to be no less important than the military.

The officers composing the War Department's committee on education and special training and its able civilian co-workers deserve congratulations.

Women Street Cleaners Proposed

The Civil Service Commission of New York City has announced that as a means of filling the rapidly-increasing number of vacancies due to war conditions women will be employed as street sweepers in the outlying districts of the city.

Muscle Shoals Dam Work Suspended

Work on the dam for the hydro-electric project at Muscle Shoals, Ala., has been ordered temporarily suspended by the War Department on representation from the War Industries Board that labor and materials used there are needed to meet immediate war demands. This dam is intended to develop power to be used eventually at the Government nitrate plant at Sheffield, Ala., near by. For the present, however, the Sheffield plant is to be operated by steam power and by electricity brought from other hydro-electric plants. It was not expected that the Muscle Shoals project would be completed for several years. Preliminary work on the dam was first in charge of Col. Hugh L. Cooper, and after Colonel Cooper returned to construction work in France it was put in charge of Major D. A. Watt, who was the Government engineer officer on the Troy dam on the Hudson River.

More Engineer Officers Made Generals

In the list of new generals sent to the Senate by the President on Aug. 22 are the names of three officers in the Corps of Engineers. To be brigadier generals in the army of the United States, for the duration of the war, are Col. Henry C. Newcomer and Col. Harley B. Ferguson; to be brigadier general, United States Army (permanent promotion) is Col. Amos A. Fries.

Col. Guy E. Tripp, late of the Westinghouse companies, is also promoted to brigadier general in the ordnance department.

Federal Bill to Enlarge Central Power Plants

A bill appropriating $200,000,000 to enlarge central power stations wherever war industries may require was introduced in the House of Representatives Aug. 19 by the Hon. T. W. Sims, chairman of the Interstate Commerce Committee, and was urged by Secretary Baker before that committee Aug. 23. The bill gives broad authority to the President to make contracts with the owners of any existing power plant for its enlargement, or to take it over as a whole, or to construct new plants. While the bill is primarily intended to finance enlargements of steam power plants it gives full authority over hydroelectric plants as well, except that structures affecting navigation require previous approval by the Chief of Engineers.

In explaining the necessity for the

(Concluded on p. 423)

"Berlin or Bust"

To my fellow engineers
who have been left behind:

Somewhere in America
August 10, 1918

This is my office.

I am the high mogul here.

It's true it is not a fancy office building, and the furnishings are all home-made. There is not a square inch of mahogany or oak in the whole layout.

The flies are something fierce. I have screens on four small openings but one large opening is innocent of protection. Such is the consistency of an engineer.

My next-door neighbor on one side is a 30 x 30-ft. storehouse, piled 12 ft. high with cement in its unused state. The voids are filled with a miscellaneous and villainous assortment of tools for various uses.

My neighbor on the other side is a 16 x 20-ft. tent filled with the same commodity.

On another side is a trunk-line railway.

From my desk I look through the window and very, very often I see a long train of khaki-clothed boys. Sometimes they are headed toward Berlin. Other times away from Berlin. Then they are bound to some training camp for the preparatory course.

But no matter which direction they are traveling, they are all going to the same place eventually. The slogan is always the same,

"Berlin or Bust"

Owing to circumstances beyond my control I am not with them—except in purpose.

I am honored by the position in this fly-specked, mosquito-bitten office. My consolation is the hope that I am doing something that should be done.

From this office, thousands of dollars are being spent for war work. The slogan of the force, like that of the boys, is "Berlin or Bust."

Sometimes we become dissatisfied. We shout for more money. Living expenses appear to be tied to the tail of an airplane.

But we are buying Liberty Bonds and W.S.S. We have had to cut down our expenses all along the line to do it. The theater knows us no more and we have abandoned the use of clothing to the limit of the law.

But our slogan is always the same

"Berlin or Bust"

Lafayette, we are here!

Pershing, we are with you!

A CHIEF ENGINEER
AND HIS STAFF

Engineering Activities at the Western Front

1 AND 2. BUILDING TWO TYPES OF BRIDGES AT ONE POINT

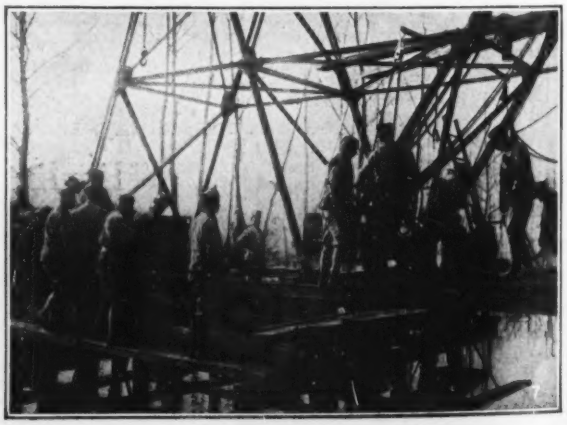
3. PREPARING THE SUBGRADE FOR A ROAD

4. CARRYING A DRAINAGE CULVERT UNDER THE SUBGRADE

5. GRAVEL PIT IS WORKED WITH BELT CONVEYORS

6. CAMOUFLAGE CONCEALS THIS PILEDRIVING OPERATION

WHEELING A TRUSS BRIDGE INTO PLACE



Bill to Enlarge Power Plants

(Concluded from p. 420)

bill, Secretary Baker said that power companies were reluctant to undertake large extensions of their plants, since the investment necessary at the present time is nearly double what it would be under ordinary conditions. It is contended that the excess of cost due to war conditions should be borne by the Government. It is stated that in both shipbuilding work and munitions manufacture a large increase in power is urgently needed and can be most economically obtained by development at central power plants.

New England Water Men Will Hold Win-the-War Meeting

The proposed help-win-the-war meeting of the New England Water-Works Association, announced by C. E. Davis, president, in a letter published in *Engineering News-Record* of Aug. 15, p. 329, will be held at the association headquarters, Tremont Temple, Boston, Sept. 11-12. The usual exhibits, excursions and entertainment features will be eliminated. Besides an experience meeting on labor troubles there will be discussions on fuel conservation, boiler-room practice and its adaptation to changing fuel conditions, the expediency of raising water rates to offset increasing costs of water service, and practical means for detecting leaks in underground pipes. The committee on frozen service pipes, appointed to gather data on experiences during the extreme cold weather of last winter, will submit its report. Willard Kent, Narragansett Pier, R. I., is secretary and S. E. Killam, 1 Ashburton Place, Boston, has charge of arrangements.

New York Meetings Committee of American Society Appointed

C. M. Holland, chairman, and J. B. French, A. W. Tidd, J. O. Eckersley, E. N. Layfield, E. B. Besselievre and Charles Gilman have been appointed the members of the New York meetings committee of the American Society of Civil Engineers, the creation of which was voted by the board of direction some time ago. The resolution creating the committee stipulated that at the second meeting of each month "the program of papers, addresses or discussions shall be placed in the hands of a committee of seven resident members to be appointed by the executive committee . . . this committee to be charged with the sole responsibility for the conduct of these meetings."

Regular business meetings, and the presentation for discussion of professional papers, are to be continued at the first meeting of each month. The first meeting of the coming season, however, that of Sept. 4, will be of the informal nature, the speaker being the military expert of a newspaper; and it is understood that there are likely to be few formal papers discussed or published during the coming year.

Highways Council Announces New War Policy

Governing Features and Procedure To Obtain Permission for Road Work Outlined

The character of the highway work which will be considered, the order of importance of the various types, and definitions of what constitute highways of military and of National economic value, are outlined in a new policy announced by the United States Highways Council to go into effect Sept. 10. A detailed method of procedure to be followed in applying for permission is established, and the necessary forms to be filled out are presented and explained. All applications must go through the various state highway departments as heretofore. The council hopes that all highway officials will coöperate in cutting down road work to the most essential needs, and requests that its recommendations and forms of application be carefully followed.

The character of work affected by this announcement is all proposed highway, street, culvert, and bridge construction, reconstruction and maintenance involving: (a) Issuance of bonds; (b) use of rail or water transportation; (c) use of coal or oil as fuel; (d) use of cement, brick, asphalt, oil, tar, crushed stone or steel (also sand and gravel where shortage exists) as highway material. No manufacturer will furnish any road-building material until the project has first been approved by the United States Highways Council.

In passing upon applications for projects, the council will give first consideration to maintenance, with a view to conserving all highways already completed. Reconstruction will be favorably considered only where it is clearly established that maintenance is no longer possible except at prohibitive cost. New construction will be considered in the following relative order of importance: (1) Highways and streets of military value; (2) highways and streets of National economic value; (3) unfinished contracts incurred prior to April 5, 1918, where a bond issue is involved, and which may not be disturbed without serious consequences; (4) streets and highways which, although not of National economic importance, are of extreme local importance, or the construction of which has progressed to such a point as to cause serious hardship, if completion is postponed.

Definitions

Defining highways of military and of National economic value, the announcement reads as follows:

"A highway of military value is one used regularly for the transportation of military supplies in considerable quantity; for the movement as an established practice of army truck trains; or a road which is essential to the efficient operation of a military cantonment, post, or plant.

"A highway of National economic value is one which serves or will serve, if properly improved, directly to promote the welfare of the nation, and not merely the local welfare.

"As examples, it may be stated that in this class would be placed (1) highways which, although not directly used for military purposes, yet serve to help win the war by greatly facilitating the output or movement of war munitions and supplies; (2) highways which can clearly be shown to relieve congestion of railroad lines in a territory which is actually in need of such relief; (3) highways which give access to or promote the output of natural products needed by the nation to a marked degree; (4) highways which further housing operations undertaken by the Federal Government, or by other agencies with the approval of the Federal Government, will justify at times this designation."

Coöperative Development of Program

In coöperation with the Office of Public Roads of the Department of Agriculture, and the state highway departments of the several states, the council will shortly begin the preparation of a program of road and street construction, reconstruction and maintenance, throughout the United States, for the working season of 1919. The purpose of this program is to obtain, approximately, the character and amount of street and highway work deemed essential, together with an approximation of the amount and character of financing required, the amount and character of the various materials entering into the work, the extent to which rail and water transportation will be involved and the probable demand upon the labor supply. The program in each state will be prepared by the state highway department, and will cover all state, county, township and municipal highway and street work.

State highway departments are requested to give most careful consideration to each application on its merits, in the light of the policy announced by the council, and to exercise the power of disapproval freely. Only projects approved by the state highway departments will be considered, unless the department itself is in doubt and wishes a decision in the nature of a precedent. For the purpose of expediting this program, certain forms have been prepared as follows: Form HC-3 is an application to the United States Highways Council for approval of a project, and is to be signed by public officials and filed with the state highway department, which, upon approval, will present it to the United States Highways Council; Forms F-1 and F-2, heretofore used for applications for bituminous materials, have been superseded by Form HC-3, but may be used, if desired, where only bituminous materials are required; Form HC-4 is a schedule for use in submitting the program of proposed highway and street work for the working season of 1919. This schedule is made up for the various political divi-

sions, with a separate schedule for construction, reconstruction, and maintenance.

It is hoped that the selective consideration of new highway and street construction by the township, county and municipal officials and the state highway departments will so materially eliminate the less essential projects as to make it possible for the council to render active aid on approved projects. The aid contemplated will be in the form of such action by other Government agencies involved as will remove obstacles to speedy completion.

The council again urges that new highway and street construction be confined to the most essential needs. If this be done, there will be a far greater probability that work thus selected can be promptly and effectively carried through to completion, than if an amount far in excess of the available facilities were to be undertaken.

Floods Damage Arizona Canal

Recent floods have caused 15 breaks in the Arizona Canal, ranging from 200 to 1500 ft. in length, the worst of these being at Scottsdale. The total estimated damage to the canal system and railroads is $500,000.

New Contracts Let for Camp Garbage and Manure

Separate Bids Received for Bread, Meat, Bones, Other Garbage, Manure and Carcasses

Contracts for the disposal of garbage at 34 army camps and for the disposal of manure at 21 camps have recently been awarded by the Conservation and Reclamation Division of the Quartermaster's Department, U. S. A., as shown by the accompanying table. The garbage bids were divided into a half dozen elements. A seventh column gives the estimated total yield per ton of garbage. These figures range from $2.41 per ton at Camp Greene, N. C., to $22.176 at Camp Fremont, Calif., and show an average of $9.38 a ton. At a majority of the camps the military authorities deliver the garbage to the contractor.

A partial list of camp garbage contractors for the year ended June 30, 1918, was published in *Engineering News-Record* of Oct. 18, 1917, p. 731. Quantities of garbage and other wastes collected at a considerable number of camps in 1918 were printed in *Engineering News-Record* of July 4, 1918.

CONTRACT AWARDS FOR DISPOSAL OF GARBAGE AND MANURE AT U. S. ARMY CAMPS

	Garbage									Manure					
		Per 100 Pounds					c								
Camp	Garbage Contractor	a Breads	b Meats, Fats, Grease	Trap	c Bones	d Other Garbage	Dead Animals, Each	Estimated Yield per Ton	Contract Expires	Manure Contractor	Price per Animal per Month	Price per Ton	F.O.B. Cars	Delivered at Siding	Contract Expires
Beauregard, La.	Hart Brothers (a&d), Steinburg & Co. (b&c)	$0.60	$3.00		$1.00	$0.40		$11.76	6/30/19						
Cody, N. M.	Geo. Turvey, Sr.	2.00	2.00		.50	.25		8.86	6/30/19						
Custer, Mich.	United Disposal & Recovery Co.	1.00	2.75	.50	.60	.04	$2.50	6.654	s 6/30/20	Michigan Agricultural College	$6.00 per car		X		No contr't
Devens, Mass.	Ayer Contracting Co.	.20	8.00		1.00	.05	2.50	15.07	s 6/30/19	U. S. Cons. Co.	.33 camp .27 remount			X	s 6/30/19
Dix, N. J.	General Mfg. Co.	4.33	4.96		.95	.05½	1.50 3.00	11.98	s 6/30/19	John E. Meehan & Son	$0.38			X	s 6/30/19
Dodge, Iowa	United Disposal & Recovery Co.	1.00	3.00	.50	.70	.05	3.00	7.41	s 6/30/19						
Doniphan, Okla.	N. A. Robertson	2.05	4.02		.52	.08	2.10	9.784	s 6/30/19						
Fremont, Calif.	Pacific Hog Co.	2.65	7.00	6.50	1.10	.41		22.176	s 6/30/19	John W. Moffitt	.15			X	s 6/30/19
Funston, Kan.	Nat'l Pro. Sal. Co.	1.50	2.50	8.00	.50	.18½	2.00	9.11	s 6/30/20						
Gordon, Ga.	Henry Knight & Son	1.50	3.25		.90	.12	2.00	9.40	s 6/30/19	U. S. Cons. Co.	.26			X	s 6/30/19
Grant, Ill.	United Disposal & Recovery Co.	1.00	4.50		.80	.05	3.00	10.15	s 6/30/20						
Greene, N. C.	Wm. J. Cocke	.25	.20		.22	.10½		2.41	s 6/30/19	T. Croft Woodruff	.15			X	s 6/30/19
Hancock, Ga.	Henry Knight & Son	1.00	3.25	1.00	1.00	.12	2.00	9.44	s 6/30/19	Buffkin & Girvin	.40			X	s 6/30/19
Humphreys, Va.	Callender, Conrad & Lawler					.04½			s 6/30/19	Miss E. M. Sharpe	.75			X	s 12/31/18
Jackson, S. C.	Henry Knight & Son	1.50	3.25		.90	.10	2.00	8.97	s 6/30/19	Powell Fuel Co.	.12½			X	s 6/30/19
Johnston, Fla.	Henry Knight & Son	1.50	3.25		.90	.11	2.00	9.17	s 6/20/19	Buffkin & Girvin		$1.60		X	s 6/30/19
Kearny, Calif.	F. M. Sayre	One cent per man per month							s 1915-Old contract renewed						
Lee, Va.	Nat'l Cont. Co.	5.00	2.00		.75	.02½		6.05	s Cancellation clause	Southern Calif. Fertilizer Co.	.15			X	s 6/30/19
										F. B. Lindsay	.21			X	s 6/30/19
Lewis, Wash.	Camp By-Products Co.	.50	.50		.60	.15									
	Camp By-Products Co.	.65	.65		.78	.30	1.00	5.69	s 6/30/19	Camp By-Products Co.	.13		X		s 6/30/19
Logan, Tex.	Joffrey Royalty Co.	.40	.40			.30		6.20	s 6/30/19						
McArthur, Tex.	Charles S. Durham	7.75	per kitchen per month						Old contract renewed						
McClellan, Ala.	Rhea & Rhea	.17½	.17½		.17½	.17½	1.25 2.50	3.50	s 6/30/19	Wm. W. Mendenhall	.05½			X	s 6/30/20
Meade, Md.	General Mfg. Co.	4.33	5.01		.95	.05½	3.00 1.00	12.04	s 6/30/19	John E. Meehan & Son	.08			X	s 6/30/19
Merritt, N. J.	Products Mfg. Co.	.25	4.00		.90	.05½	1.50	9.38	s 6/30/19						
Newport News, Va.	Nat'l Contracting Co.	3.00	2.00		.75	.02½	1.00	5.655	s 6/30/19	Virginia Reclamation Corporation		.60	X		s 6/30/19
Pike, Ark.	Guy W. Caron	2.00	4.50	2.00	.75	.06	1.50	10.40	s 6/30/19						
Sevier, S. C.	Greenville - Carolina Trust Co.	.50	.50		.50	.20		5.02	s 6/30/19	Powell Fuel Co.	.12½			X	s 6/30/19
Shelby, Miss.	R. L. Bradly	100.00	per month						Cancellation clause	R. L. Bradly	.12½			X	s 6/30/19
Sheridan, Ala.	U. S. Cons. Co.	1.00	4.50		1.50	.06	3.00	11.39	s 6/30/19	U. S. Cons. Co.	.10			X	s 6/30/19
Sherman, Ohio	Henry Knight & Sons	1.50	3.25		1.10	.13	2.50	9.86	s 6/30/19	Sold to farmers and Swift Co.				X	
Taylor, Ky.	Price Vogt Stock	1.50	3.50		1.05	.16		10.76	s 6/30/19						
Travis, Tex.	W. C. McCord Feeding Co.	1.20	2.75		.75	.41		12.13	s 6/30/19						
Wadsworth, S. C.										Powell Fuel Co.	.20½			X	s 6/30/19
Wheeler, Ga.	U. S. Cons. Co.	1.00	4.50		1.50	.06		11.39	s 6/30/20	U. S. Cons. Co.	.22			X	s 6/30/20
Upton, N. Y.	Products Mfg. Co.	.25	4.00		.90	.05½	1.50 3.00	11.05	1920	Wm. L. Peck	.21			X	s 6/30/20
Average		1.46	3.13		.83	.135	2.10	9.38			.26	.50			

s Standard form of contract.

Army Death Rate Low

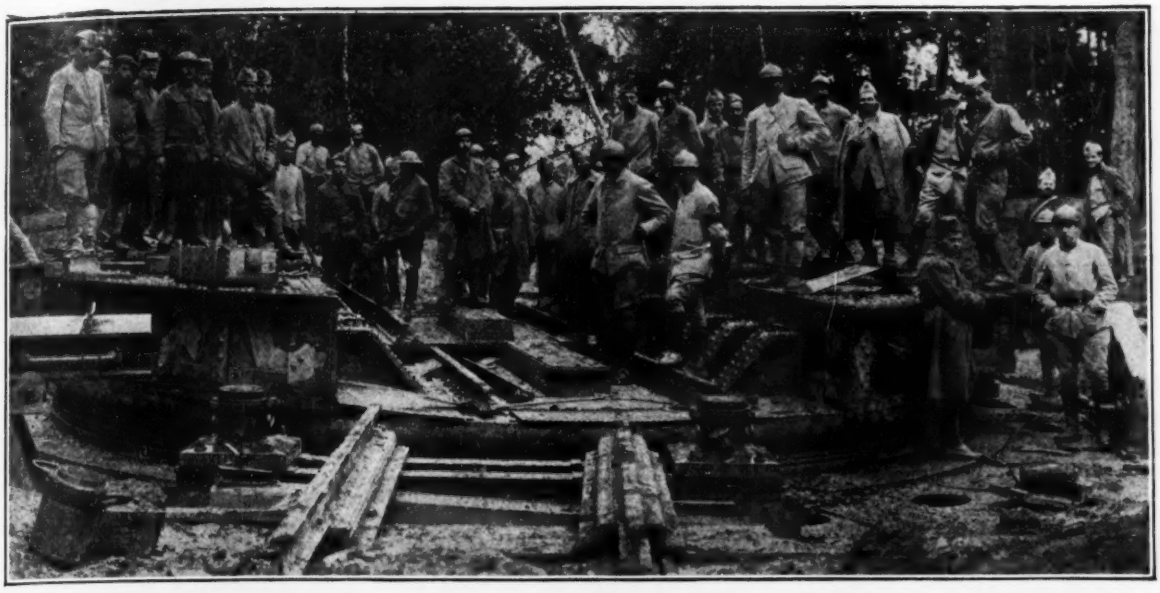
Combined reports for the American armies at home and abroad showed a death rate from disease of 1.9 per 1000 per annum for the week ended July 26, based on a total of 2,500,000 men. For the past two months the rate was 2.8. The rate for men of military age in civil life is 6.7. Records for earlier wars, according to the office of the surgeon-general, were: Mexican, 100; Civil, 40 in 1862 and 60 in 1863; Spanish-American, 25; Russo-Japanese (for Japanese troops?), 20. (It should be noted that the civil rate and the earlier war rates cited are for long periods.—Editor.)

Progress on Proposed Connection with Laguna Dam

The board of directors of the Imperial Irrigation District have signed the Government contract submitted by Secretary Lane covering the terms under which connection with the Laguna dam is to be made. This action must be ratified by popular vote.

It is reported that the contract is not satisfactory to the people of Imperial Valley and that the approval of the board was given to it only in order that the voters of the valley might have a chance to express their opinion.

First Photographs of Emplacement for New 75-Mile Gun, Captured by U. S. Troops in Recent Sweep Above Marne



Capital Issues Committee Will Co-operate

The United States Highways Council has been assured that the Capital Issues Committee desires to coöperate with it in selecting road construction projects. This is the outcome of the controversy outlined in *Engineering News-Record* of Aug. 15, p. 352. In conference with representatives of the Highways Council, the Capital Issues Committee agreed to transmit verbatim the minute passed by the council, which stated that it would be advantageous, if the Capital Issues Committee would depend upon the Council for recommendation as to military and technical phases of proposed highway improvement, and leave to the subcommittee of the Capital Issues Committee only the financial aspects of the proposed bond issues.

Those interested in highway problems are hopeful that better conditions will result from such coöperation.

New Jersey Convicts Will Work on State Highways

Convicts in New Jersey are to be put to work under a comprehensive program recently outlined by Governor Edge. State-prison convicts assigned to outside work will be sent this fall to clear and drain land and do other work at a state farm and, if a quarry can be leased, to produce trap rock for highways. Next spring inmates of the state prison and of the state reformatory will be put on state highway work. Work in a state nursery under the Conservation Commission is proposed. Prisoners kept within institutions will do a variety of work. The plan involves social and industrial reclamation as well as labor utilization.

© Committee on Public Information

TURNTABLE MOUNT FROM WHICH GERMANS INTENDED TO BOMBARD PARIS WITH ANOTHER "GROSSE BERTHA," PHOTOGRAPHED BY OUR SIGNAL CORPS

Will Study Effect of Powder Plant on Nashville Water

The effect of chemical wastes from the Old Hickory powder plant on the water-supply of Nashville, Tenn., which was reported on some time ago by Prof. Earl B. Phelps of the United States Public Health Service, will be further investigated by Dr. W. H. Hollinshead of Vanderbilt University, Professor Phelps and Prof. George C. Whipple, Harvard University.

Sand, Gravel and Stone Placed on Nonessential List

Sand, gravel and stone have been placed by the Railroad Administration upon the list of nonessentials, except where shipments are for war industries purposes. This ruling was made Aug. 20, and hereafter open-top cars will not be available for transportation of such commodities, it is stated.

The reason assigned for this order was that the war industries, army,

navy and merchant marine have such large coal requirements that open-top equipment cannot be used for other commercial traffic. Such curtailment rules will, it is thought, tie up every sort of building activity, but officials are said to believe that this is the only method of staving off a winter shortage of coal cars. It is hoped that the maximum production of the mines can be handled during the winter.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

NEW ENGLAND WATER-WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 11-12, Boston.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

The Detroit Engineering Society will hold its opening meeting of the season Sept. 6 in the auditorium of the Detroit Board of Commerce. H. H. Esselstyn, past president of the society and now commissioner of public works of Detroit, will address the meeting on "The Hog Island Shipyard." On Aug. 26 the society attended a meeting called by the advisory board on fuel conservation, United States Fuel Administration, at which the general subject of coal conservation as applied to industries was discussed.

The Smoke Prevention Association made a trip of inspection by automobile to the Pequannock watershed on the afternoon of Aug. 21, as guests of the local committee of Newark, N. J., where the association is holding its annual convention, as mentioned in *Engineering News-Record* of Aug. 15, p. 338. In the morning of the same day William A. Pittsford of Kewanee, Ill., addressed the meeting on "Burning Bituminous Coal Smokelessly." Other papers which have been read before the convention are: "Burning a Million Tons of Coal a Year," by Frank W. Casler, general superintendent of production of the Public Service Corporation of New Jersey, in which was pointed out the economy from efficiency of equipment attained through the operation of 16 generating stations as a single unit; and "Smokeless Operation with Chain-Grate Stokers," by Thomas Marsh, chief engineer of the Green Engineering Co., Chicago.

PERSONAL NOTES

EDWARD STUART, who was sanitary engineer for the American Red Cross in the Balkans, 1915-17, and recently a member of the Red Cross Relief Commission to Guatemala, has been commissioned as captain in the Sanitary Corps, and will handle sanitary problems at the Macedonian front.

ROBERT W. GAY, for the past eight years professor of civil engineering at the Mississippi Agricultural and Mechanical College, has resigned to become office engineer for the Morgan Engineering Co., Memphis. For ten years previous to his service as professor of civil engineering he was engaged in municipal, hydroelectric development and other engineering work.

R. A. ROSS, consulting engineer, Montreal, has been appointed by the Canadian government as chairman of the Lignite Utilization Board, which will have charge of the plant to be established in Saskatchewan for briqueting lignite for domestic fuel. As a member of the Canadian Advisory Council for Scientific and Industrial Research, Mr. Ross has given considerable attention to the use of Western lignites.

CHARLES E. WELLS, division engineer, Board of Water Supply, New York City, has become supervising engineer for the division of shipyard plants, Emergency Fleet Corporation, assigned to duty in charge of construction of the concrete shipbuilding plant at San Diego, Cal. Mr. Wells was supervising engineer at Camp Merritt, New Jersey, during its construction.

G. F. SCHLESINGER, for several years assistant professor of civil engineering at Ohio State University, has been appointed assistant chief examiner in charge of the examination division of the Civil Service Commission of Ohio. Professor Schlesinger was graduated from Ohio State University in civil engineering in 1907, and afterwards served five years with the Rock Island Lines as assistant engineer on the St. Louis division.

F. T. DARROW, engineer maintenance of way of the lines west of the Chicago, Burlington & Quincy R R., has been appointed assistant chief engineer of the lines west. The position of engineer maintenance of way has been abolished. Mr. Darrow, after his graduation from Allegheny College in 1897, began railroad work the same year with the Burlington system. In 1902 and 1903 he was resident engineer on the reconstruction of the Missouri River bridge at Plattsmouth, Neb. For a short time in 1905 he was manager of the International Contract Co., Seattle. Late in the same year he became engineer maintenance of way of the Nebraska district of the Burlington; shortly thereafter he was made principal assistant engineer, and in 1908 was made engineer maintenance of way of the western lines.

FRANK C. LINGENFELTER, principal assistant city civil engineer of Indianapolis, has been appointed city civil engineer, succeeding Henry W. Klausmann, whose death was noted in *Engineering News-Record* of last week, p. 381. Mr. Lingenfelter was graduated from Purdue University in 1894. He entered the office of the city civil engineer in 1907, and since that time has specialized in track elevation work. In March, 1918, he was appointed principal assistant city civil engineer. Before he entered the office of the city engineer he was in the contracting business and in the engineering department of the Big Four Railroad.

W. W. K. SPARROW, valuation engineer of the Chicago, Burlington & Quincy R.R., has been appointed chief engineer for the corporation of the Chicago, Milwaukee & St. Paul Ry. Mr. Sparrow was born in Ireland in 1879. His first engineering work was with the Belfast & Northern Counties Ry., and for ten years he was in railroad work in South Africa. About 1908 he came to the United States, and for three years was engaged in steel and reinforced-concrete design with Waddell & Harrington, consulting engineers, Kansas City. Following that he was a year with Hans von Unwerth, consulting engineer, also in Kansas City. In September, 1913, he was made assistant chief engineer of the Missouri Public Service Commission. In March, 1916, he was appointed valuation engineer of the Chicago, Burlington & Quincy Railroad.

WILLIAM S. MOORE, state highway engineer of Indiana, has received a leave of absence from the Indiana State Highway Commission, to become associated with the Silvex Co., Bethlehem, Penn., as efficiency engineer. As stated in *Engineering News-Record* of May 15, p. 976, the work of the Indiana State Highway Commission was stopped by a court injunction regarding the validity of the state highway commission law.

JOHN W. ENNIG, chief engineer of A. Bolter's Sons, Chicago, manufacturers of structural steel, has become manager of the structural steel department of Wendnagel & Co., structural steel and wooden tank manufacturers, Chicago.

G. W. HARRIS, recently chief engineer of the Coast lines of the Atchison, Topeka & Santa Fé Ry., has been appointed chief engineer for the Santa Fé corporation. Mr. Harris entered the employ of the Santa Fé system in 1899,

and up to 1906 was successively chainman, rodman, transitman and assistant engineer. From 1906 to 1909 he was assistant engineer in charge of grade and line revision of the Pecos & Northern Texas Ry., and from 1909 to 1912 was chief engineer of construction. In April, 1912, he was made chief engineer of the Coast lines of the Santa Fé system.

LOUIS B. MANHEIMER, formerly assistant engineer in charge of the topographical bureau of Queens County, New York, with headquarters in Brooklyn, has been promoted from first lieutenant to captain in the Engineer Officers' Reserve Corps.

M. I. EVINGER, consulting sanitary engineer, Des Moines, Iowa, who was in charge of the department of sanitary engineering at Iowa State College, is now serving as a captain in the utilities branch of the Quartermaster Corps at Camp Dodge, Iowa, as officer in charge of water supply and sewerage.

HENRY B. MACHEN, borough engineer, Department of Water Supply, New York City, has been commissioned as major in the Ordnance Reserve Corps, and assigned to duty with the Production Division.

FINLAY L. MACFARLAND has been elected president of the Board of Water Commissioners of Denver, which was recently elected as the first Board of Water Commissioners of the city when it was voted to take over and operate the Denver Union Water Co., as noted in *Engineering News-Record* of Aug. 15, p. 336.

HENRY L. TATNALL has been appointed secretary and engineer of the Board of Park Commissioners of Wilmington, Del.

ALLAN F. OWEN, who has been associated with George C. Nimmons & Co., architects, Chicago, as engineer, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps, assigned to duty at Camp Humphreys, Virginia.

CAPT. W. GERALD HAWES, president of the John Wilfert Co. and the Hawes Foundry and Equipment Co., has been appointed to the chairmanship of the Brooklyn, N. Y., district of the United States Shipping Board.

ALLEN B. MCDANIEL, professor of civil engineering, Union College, Schenectady, N. Y., is now located in Washington, D. C., as expediting engineer for the camp and cantonment section of the Construction Division.

A. R. DUFRESNE, assistant chief engineer of the Canadian Department of Public Works, has resigned to become manager of the St. John Drydock & Shipbuilding Co., St. John, N. B.

F. L. THOMPSON, assistant chief engineer of the Illinois Central R.R., has been appointed chief engineer, succeeding A. S. Baldwin, whose appointment as vice president of the Illinois Central corporation was mentioned in these columns last week. Mr. Thompson was engineer of construction of the Illinois Central when promoted to assistant chief engineer four years ago. Before that he was engineer of bridges and buildings.

THOMAS L. COSTIGAN, principal assistant inspector for the building inspection department, Washington, D. C., has been appointed superintendent of street cleaning, succeeding J. W. Paxton, resigned.

W. R. ROOF, assistant engineer of bridges of the Chicago Great Western R.R., has been appointed bridge engineer.

H. D. MORAN, superintendent of the Casparis Stone Co., Connellsville, Penn., has resigned to become superintendent of the plant of the Southern Mineral Co., Winnfield, La.

C. L. PERSONS, assistant engineer on special work for the Chicago, Burlington & Quincy R.R., has been appointed assistant chief engineer of the lines east of the Missouri River. Mr. Persons has been with the Burlington system since 1904. From 1908 to 1916 he was locating engineer on the lines east, and in the latter year was assigned to special work, as a member of the chief engineer's staff.

M. A. STAINER has become assistant valuation engineer for the Fort Worth & Denver Ry., with headquarters at Fort Worth, Tex.

J. X. COHEN, who was designing engineer for the Syracuse, N. Y., intercepting sewer board, is now associated with Chester & Fleming, supervising engineers for the Field Artillery Firing Center at Stithton, Ky.

ELMO A. FUNK, city engineer of Anderson, Ind., has resigned to enter the engineering department of the Hill Pump Co. at Anderson.

EARL STIMSON, engineer maintenance of way of the eastern lines of the Baltimore & Ohio R.R., has been appointed general superintendent maintenance of way and structures of all lines under the jurisdiction of A. W. Thompson, Federal manager. Mr. Stimson was born in Cincinnati in 1874. He was educated at the University of Cincinnati and at Cornell University, being graduated from the latter university in 1895. The same year he entered railroad service in the maintenance of way department of the Baltimore & Ohio Southwestern. He was promoted to assistant engineer in 1896, to resident engineer in 1899, to assistant division engineer in 1901, division engineer in 1902, engineer maintenance of way of the Baltimore & Ohio Southwestern in 1905, and engineer maintenance of way of the eastern lines of the Baltimore & Ohio in 1910.

R. T. MCCLELLAND, of the engineering department of the Blaw-Knox Co., Pittsburgh, Penn., has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps.

CARL P. ABBOTT, formerly assistant works engineer for the Air Nitrates Corporation, Muscle Shoals, Ala., has become works engineer.

J. B. MYERS, district engineer maintenance of way of the Baltimore & Ohio R.R., with office at Baltimore, has been made engineer maintenance of way of the eastern lines, succeeding Earl Stimson, promoted.

OBITUARY

GEORGE WILLIAM DICKIE, naval architect and marine engineer, who had been associated with engineering and shipbuilding on the Pacific Coast for nearly 50 years, died suddenly at his home in Oakland, Cal., Aug. 17, at the age of 74. A native of Arbroath, Scotland, Mr. Dickie came to the United States in 1869, establishing himself in San Francisco. Soon after this time he designed the first successful triple-expansion engine built in the United States, and a few years later designed the first Scotch marine boiler on the Pacific Coast. From 1870 to 1883 he was connected with the old Risdon Iron Works, first as a draftsman and later becoming consulting engineer, during which time he designed the machinery for deep mining operations for the famous Con-Virginia Mine, including the deepest pumping apparatus in use up to that time. In 1883 Mr. Dickie became general manager of the Union Works, remaining in this position until 1905, when the plant was purchased by the Schwab interests. During that period he designed many privately-owned ships as well as a large number of Government vessels, the best known of which are the old battleships Oregon, Wisconsin and Ohio and the cruiser Olympia, which became Admiral Dewey's flagship. He retired from active work about four years ago, but, following this country's entry into the war, offered his services to the Government. At the time of his death he was resident inspector for the United States Shipping Board at the Moore Shipbuilding Plant in Oakland. He was a member of the Technical Society of the Pacific Coast, the American Society of Naval Architects and Marine Engineers and the American Society of Mechanical Engineers.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

For the Public's Benefit, Now and After the War

Washington Authorities Admit Soundness of Co-operation — Urge Pooling and Agreements Among Industries

(Washington Correspondence)

War throws into high relief many fundamentals. Our policy on big business has been to enforce competition. We could not dissociate coöperation from the probability of exploitation of the public. We admitted the economic soundness of coöperation, but our legislators were not equal to the task of establishing mechanism for securing the advantages and at the same time checking the predatory tendencies. The Sherman law and its successors were the best they could do. The shortcomings of these laws are now thrown into relief Pooling—a crime hitherto under the law—is suggested by the Government itself, while all manner of agreement between erstwhile competitors is urged by the authorities. The saving grace is price-fixing or the threat thereof if the coöperating producers are disposed to use their advantage against the public.

In other words, we have full coöperation, with just enough Government control to protect the public. Germany learned how to do this years ago. It has taken a bitter war to force us to see the way.

So far, the clearest endorsement of pooling comes in an order from the Fuel Administration to the cement manufacturers. It provides, among other things, that if two or more manufacturers find that they can save fuel by using jointly their allotments, they may use, upon permission from the Fuel Administration, "at one or more of such plants to be operated by them jointly, sufficient fuel to manufacture 75 per cent of the aggregate of the average annual production of all such plants when operated separately, the manufactured product of such jointly operated plants being distributed to the individual manufacturers as may be agreed between them."

Attention is called to the last clause, regarding distribution of the product. Under this regulation a company owning one of four mills in a given location could shut it down, disband its distribution organization and yet share in the returns on cement to the manufacture and marketing of which it contributed only its coal allotment. It is just this sort of shutting down and pooling that the lime manufacturers have proposed to the War Industries Board, though their proposal includes also the restriction of distribution, to prevent cross hauling (such as is now enforced in the distribution of coal). The lime manufacturers' case, too, is still more interesting because their restriction is to 40 per cent of former production, while the cement reduction is to 75 per cent.

There is no need to detail here the advantages of such pooling in the saving of man-power, the more efficient use of fuel and the saving in transportation. These are so evident that the proposal of the lime manufacturers will surely be endorsed by the War Industries Board.

These recognitions of the economic advantages of pooling and coöperation by a Government which heretofore has frowned on these practices are material gains to be put on the rather bare credit side of the war ledger. But if we hold the principles sound only for war-time, the gain will be slight. These practices should enter the structure of the remade laws that should follow the war. War has merely been the incident to show that we can secure the advantages of pooling and coöperation without also risking the assumption of the disadvantages.

Regional Advisers to Government Appointed by War Board

The United States has been divided by the War Industries Board into 20 districts headed by men appointed as regional advisers. These advisers will serve "as the points of contact between the Government and the business men of the country," and, together with subchairmen, as assistants, will act as advisers to the Government in an effort to organize the business men "to assist the Government in carrying out its war program." The districts will be known as the Boston, Bridgeport, New York, Philadelphia, Pittsburgh, Rochester, Cleveland, Detroit, Chicago, Cincinnati, Baltimore, Atlanta, Birmingham, Kansas City, St. Louis, St. Paul, Milwaukee, Dallas, San Francisco and Seattle districts. The men appointed, it is explained, will "keep in touch with business men and conditions and inform the Government as to the supply and industrial situation in their respective districts."

Indifference Deadly, Warns Chairman Hurley

"Wake Up, America" with Reference to Merchant Marine Urged by Shipping Board

The United States Shipping Board, through its chairman, Edward N. Hurley, warns the nation of the peril to the newly-created merchant marine program through indifference. In two years the carrying capacity of the fleet of merchant ships now building will be 25,000,000 tons.

To prepare for utilizing this tonnage in the short time intervening between now and the time it will be released from war work, Mr. Hurley points out, requires immediate thought on the part of manufacturers and merchants. It was the indifference of the past century that proved so deadly to our first merchant marine.

This country will have at least 3000 ships, of modern design, to accommodate which port facilities and bunkering stations are being established all over the world, and efforts are being put forth to operate the fleet efficiently.

The Shipping Board points out that one of the chief obstacles hitherto encountered in the establishment of a merchant marine was the fear of cheap foreign labor. The idea prevailed that to obtain and hold an export trade would necessarily mean the lowering of wages and American standards of living. Now, however, it is recognized that the development of foreign trade must begin with more efficient methods in our own factories. Cheapness, in connection with foreign trade, and the capture of foreign markets by lowering American standards of living, are bogies which have been exposed by recent studies of the Shipping Board. The only foundation for foreign commerce is now generally understood to lie in the American manufacturer's ability to study labor and costs together, increase efficiency and decrease labor turnover and waste.

In calling for teamwork by all organizations throughout the country, Mr. Hurley asks the following questions: "Are you taking steps to use these ships to increase your own prosperity? Do you realize that American products of factory, farm, and mine can be delivered to customers in foreign countries on terms which will build a lasting trade? Do you realize the possibilities of bringing back raw materials to extend your products and trade? Are you applying the new world vision to the interests represented in your organization and learning what ships can do towards widening your market?"

New List of Priority Industries in Preparation

The Priority Committee, under direction of the War Industries Board, is preparing a new list of preferred industries. In the announcement received from Washington it is stated that although the list is not yet complete it will probably be twice as long as the one issued last April, which contained about 32 classes.

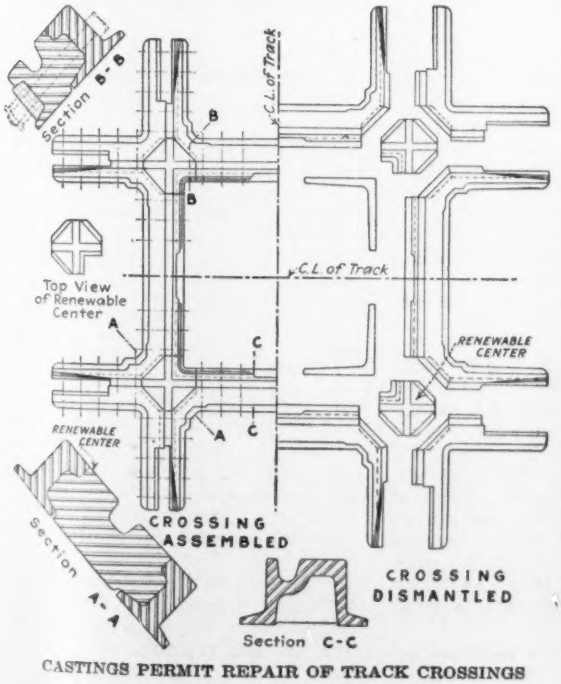
The new list will indicate what constitutes war work as interpreted by the War Department, and will be of assistance in solving the "war work or fight" ruling by men engaged in the essential industries listed.

The new list may be expected within the week. According to the statement from Washington, this amplification has been due to the widely expanded war needs and the increasing demands of important industries of civilian origin. The list is established on six basic elements of industry which are: Material, facilities, fuel, transportation, labor, capital. Each of these is represented on the Board except capital, and, it is stated, a working arrangement is established between capital and the War Industries and War Finance Boards.

Railway Track Crossing With Renewable Centers

Renewable centers for track crossing frogs of cast manganese steel have been designed in order to provide for ready repair of the parts subjected to the most severe wear, without the expense of taking up the heavy and costly crossing. Wear from passing wheels is concentrated at the intersections of the grooves or flangeways, so that these parts may require attention while the remainder of the crossing is in good condition.

In the new construction, as shown by the accompanying drawing, the crossing is built up of eight main castings, with four separate blocks or intersection pieces fitting between them. The main castings are bolted together, and the corners are reinforced by heavy inside knees. This type of crossing is made by the Balkwill Manganese Crossing Co., Cleveland.



CASTINGS PERMIT REPAIR OF TRACK CROSSINGS

Government Names Contractors on List to Lose Common Labor

A local ruling made in the District of Columbia which, if extended to the whole country, would apparently stop all construction work, was announced Aug. 22. The labor board of the United States Employment Service of the District of Columbia, acting in conformity with the declaration of the labor recruiting program, has issued a list of 25 activities which are classed as nonessential and from which the release of laborers, porters, janitors and other unskilled workers may be expected. The list includes the drivers of auto trucks engaged in work other than fuel or Government work, teaming other than delivery of products for war work, builders and contractors not engaged in the erection of structures for war work, and mercantile stores.

It is stated that the voluntary release of these men by their employers is expected without formal orders, but should this not occur formal orders will be served by the board. It is also stated that it may be necessary for the board to add to this list from time to time. Classifications are given for centralizing war labor recruiting programs for war work and include the manufacture or the erection of structures directly or indirectly supplied to the Government for war work (indirectly supplied meaning goods delivered under subcontracts, coal mining, railroads and farming, in so far as the latter is protected against labor recruiting). The making of products to be used ultimately for war purposes but not delivered directly to the Government, its contractors or subcontractors is not considered war work, and will be subject to demand on its supply of common labor as it is needed.

Plant Conditions To Be Studied to Reduce Labor Turnover

The conditions of war workers in factories will be studied by the United States Employment Service in an effort to solve the labor turnover which, according to the Employment Service, has assumed such large proportions as to endanger the volume of production. Representatives of the service and an expert in industrial management will visit one of the largest war plants of the country which has suffered from excessive turnover, and make a study of the internal conditions of the plant, in order that measures may be taken to keep the men at work. The plant at present is requiring 2000 unskilled workers a week, owing to the constant change and leaving of men

The establishment of the Employment Service has checked the rushing of workers from one plant to another by private recruiting agents, and has reduced the labor turnover to a large extent. The Employment Service believes that a further reduction of the turnover may be made by studying the internal conditions of the plants, for the purpose of removing conditions that cause the men to leave their work after a few days or weeks.

BUSINESS NOTES

The West Coast Lumbermen's Association has established a Washington office at 519 Munsey Bldg., Washington, D. C. The office will be in charge of Dwight H. Davis, recently of Chicago, and formerly connected with the lumbering industries of the West coast.

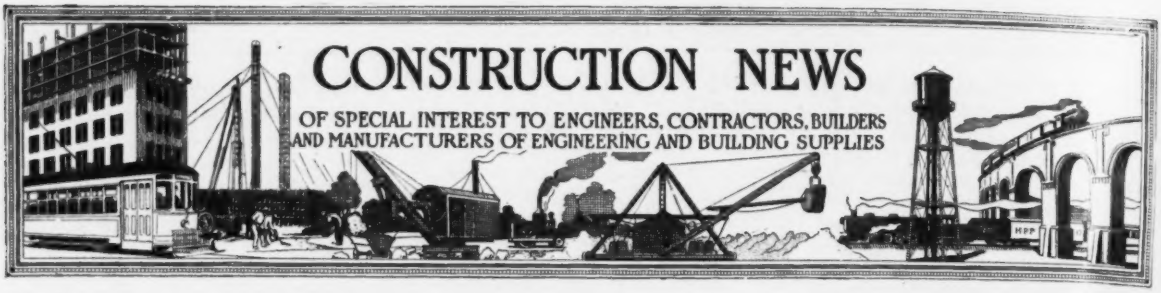
It is announced that the offices will be fully equipped to afford headquarters for the members at the capital.

E. P. Dillon, manager of the power division of the New York office of the Westinghouse Electric & Mfg. Co., has resigned to become general manager of the Research Corporation of New York.

TRADE PUBLICATIONS

"Warner Heavy-Duty Truck Trailers" is the title of two bulletins received from the Warner Manufacturing Co., Beloit, Wis. One illustrates its two-wheeled heavy-duty 1¼- to 5-ton capacity trailers, the other its four-wheeled type, of 1½- to 7-ton capacity.

"Housing Labor" is the subject of a 36-p. book, 8 x 11 in., issued by the Gordon-Van Tine Co., Davenport, Iowa. Its main purpose is to advocate frame buildings made with lumber ready-cut and shaped for erection.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

Six Months' Excavation and Miscellaneous Contracts Compared

Amount of Private, City and State Contracts Greater than that of Federal Government Work

The total amount of contracts awarded for private, state and municipal work exceeds that of the Federal Government work as reported in the columns of *Engineering News-Record*. The private, state and municipal work will be classed as private work in the following comparisons. The total amount of private contracts reported is $22,542,589 and for the Federal Government $11,390,077.

The private work does not include the port and canal work now in progress at New Orleans recently described in *Engineering News-Record*. It was announced that it would be done by day labor and it was estimated to cost about $6,000,000. Without this large item the percentage of the above figures amounts to 66 for private and 34 for Government work. In excavation and dredging alone the division is 57% for private and 43% for Government work. The miscellaneous items include some railway contracts, equipment, such as boilers, generators, heating systems, etc., together with such construction as dams, locks, port works, etc. Seventy per cent. of these contracts are in private and 30% in Government work.

Figs. 1 and 2 show these distribu-

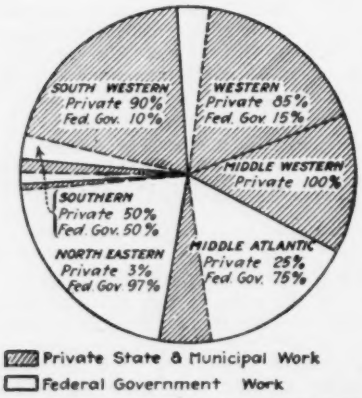


FIG. 1. EXCAVATION AND DREDGING CONTRACTS BY DISTRICTS

tions by districts, and it will be noticed that Federal Government work predominates in the Northeastern and Middle Atlantic States only in Fig. 1. There is a slight preponderance in the Southern States for the miscellaneous contracts in Fig. 2. It will be noted especially that all the excavation and

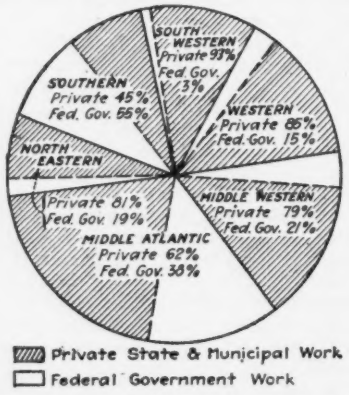


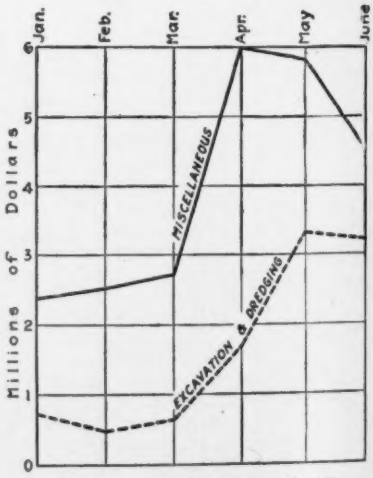
FIG. 2. MISCELLANEOUS CONTRACTS BY DISTRICTS

dredging work reported from the Middle Western States is private.

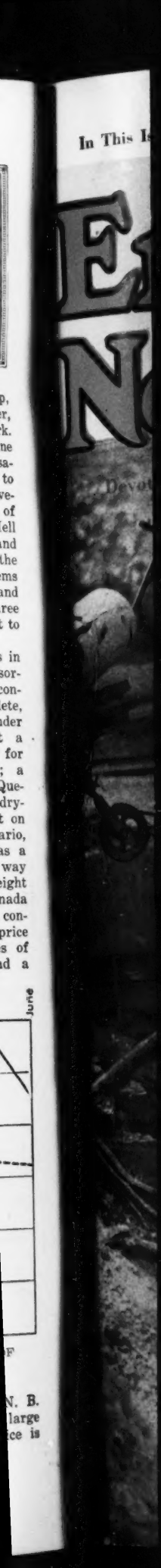
Most of the railroad items included under miscellaneous contracts are for Federal Government work in cantonments, especially those of the Navy, as well as marine railways in shipyards. The railway systems of the country have their own coterie of contractors, especially skilled, who have the machinery adapted for that work, so that railroad work is not represented to any large extent in any contracting news columns. Fifteen railroad items reported, including the Government work, amount to $2,164,478. There are 124 items under the miscellaneous columns reported for equipment, most of which were awarded by the bureau of yards and docks, Navy Department, for cantonment and naval station work. There are 119 construction items reported such as dams, culverts, retaining walls, fills, etc. Under the three headings, of excavating and dredging and miscellaneous, almost 300 items were reported, on only 40 of which no price was given. Of the items on which prices are given the average is about $11,000.

There are only eleven contracts reported ranging from $5,000,000 up, four of which are $1,000,000 and over, only two reaching the $2,000,000 mark. The Federal Government awarded one for ordnance proving grounds in Massachusetts, and another amounting to $1,993,000 is for river channel improvement at Columbus, Ohio. The two of $1,000,000 each are for dredging Hell Gate channel by the Government and for rebuilding blast furnaces by the Carnegie Steel Co. Eight of the items mentioned are for private work and amount to $6,635,000; the other three are for the Government and amount to $3,712,000.

On account of the war conditions in Canada, construction has been disorganized to a large degree. The construction news therefore is incomplete, but some large contracts are under way. In the Winnipeg district a $2,000,000 contract was awarded for tunneling under the Red River; a $600,000 contract was awarded in Quebec for work in connection with drydocks, there is a $200,000 contract on dams at St. Marys Rapids in Ontario, and the Dominion Government has a $770,000 drydock contract under way at Vancouver, B. C. All told, eight items are reported from Canada amounting to $3,894,500, and four contracts are reported on which no price is given. These include 14 miles of railway in British Columbia and a



MONTHLY DISTRIBUTION OF AMOUNTS OF CONTRACTS

large drydock at Frederickton, N. B. At Vancouver foundations for a large grain elevator, on which no price is given, are also reported.

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